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Getting to the heart of child maltreatment : a multidimensional investigation using an extended family design

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Renate Simone Marianne Buisman

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Getting to the heart of child maltreatment:
A multidimensional investigation using an extended family design

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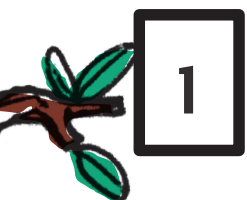
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Chapter 1

General introduction



General introduction

Maltreatment of children by their parents or other caregivers is a global phenomenon, touching the lives of millions of children (Stoltenborgh, Bakermans-Kranenburg, Alink, & Van IJzendoorn, 2015). Child maltreatment encompasses all forms of physical and/or emotional abuse, sexual abuse or neglect, resulting in actual or potential harm to the child's health, survival or development (WHO, 1999). In the Netherlands, between 90,000 and 127,000 children were estimated to have experienced at least one type of child maltreatment in 2017, some 3% of all children aged 0-17 (Alink et al., 2018).

Child maltreatment has detrimental consequences, short- and long-term, on a range of levels of functioning, including mental health functioning, stress and emotion dysregulation, and parenting of one's own children (Norman, Byambaa, Butchart, Scott, & Vos, 2012; Pears & Capaldi, 2001). Risk factors for child maltreatment have been identified at the level of the parent, child, and family, including parents' level of stress, child externalizing problems and family cohesion (Stith et al., 2009). However, precisely the involvement of processes on different levels (e.g., biology, behavior, the family environment) complicates understanding the etiology and sequelae of child maltreatment. The current dissertation, therefore, is comprised of a multidimensional multi-method investigation of child maltreatment using an extended family design. A better understanding of the processes on different levels that play a role in child maltreatment may yield innovative methods for prevention and intervention.

1

Methodological challenges in child maltreatment research

Research addressing the scope, antecedents and consequences of child maltreatment is useful to the extent that it is based on sound methodology. However, reliable measurement of the frequency and severity of child maltreatment is not straightforward due to ethical and legal difficulties (Mash & Wolfe, 1991). In addition, maltreatment might be ambiguous and often occurs behind closed doors (Smith, Ireland, Thornberry, & Elwyn, 2008). Hence, different methods and research designs can be considered.

Measurement

Studies about child maltreatment generally have used two approaches to measure child maltreatment. The first approach involves the use of reports from professionals working with children (i.e., sentinels), such as Child Protective Services (CPS) records. The use of sentinel-reports has the advantage of relying on observations of professionals in the field rather than relying on self- or family-report, thereby obtaining a more "objective" rating of a sensitive issue. A disadvantage of this approach, however, is that a large portion of maltreatment goes unnoticed by professionals and only the most severe cases are usually substantiated by CPS (Smith et al., 2008). Sentinel-reports are, therefore, generally assumed to capture only the top of the proverbial iceberg.

The second approach involves the use of parental or child self-report of child maltreatment, usually based on retrospective recollection of events. Parental and child self-report of child maltreatment are more likely to capture the whole range of maltreatment experiences. However, self-reports may be biased due to distorted memories (Edwards et al., 2001), cognitive appraisals of the experience (Smith et al., 2008), social stigma (Knight, Runyan, Dubowitz, Brandford, & Kotch, 2000), and loyalty of children towards their parents (Della Femina, Yeager, & Lewis, 1990). Estimates of child maltreatment prevalence depend heavily on the measurement approach being used, with rates of sentinel-reports being a fraction of self-reported rates (Euser et al., 2013; Stoltenborgh, Bakermans-Kranenburg, Alink, & van IJzendoorn, 2012).

Individual bias and error that go hand in hand with the use of single source approaches can be alleviated by applying a multisource approach to assessing child maltreatment (Kraemer et al., 2003). The implications of such an approach are discussed in Chapter 2, where we use a factor-analytic approach to combine the perspectives of father, mother and child on child maltreatment. In doing so, we aimed to establish components reflecting the convergent as well as the unique (discordant) reports of father, mother, and child on the occurrence of maltreatment. In the other studies (Chapter 3-5) of this dissertation, parent and child reports of maltreatment were combined – when feasible – to minimize the influence of individual reporter bias.

Maltreatment as a heterogeneous phenomenon

Along with the heterogeneity in sources used to identify child maltreatment, maltreatment itself is a heterogeneous phenomenon. Maltreatment encompasses both abuse and neglect. Child neglect implies an act of *omission* and is related to the failure to meet the child's physical (i.e., food, shelter) and emotional needs (i.e., attention, affection), whereas child abuse implies acts of *commission* which can be emotional (i.e., threatening, humiliating) or physical (i.e., burning, kicking). Abuse is therefore more easily traced back to specific incidents, whereas the absence of care or responsiveness that defines neglect may be harder to assess (Compier-de Block et al., 2016). Empirical findings indicate that abuse and neglect often co-occur (Alink et al., 2018; Herrenkohl & Herrenkohl, 2009). Because multiple forms of maltreatment in the same family are common, understanding the unique effects of abuse and neglect has proven to be difficult in research to date, and conclusions concerning abuse or neglect are frequently confounded by the other type of maltreatment. Therefore, in all studies in this dissertation (Chapters 2-5) it was examined whether abuse and neglect were uniquely associated with the variable of interest.

Research designs used to study child maltreatment

All four basic study designs – cross-sectional, retrospective cohort, case-control and prospective cohort studies – have been used in child maltreatment research. Most research

in child maltreatment involves naturalistic correlational field research that does not permit to experimentally manipulate the variables of interest and to randomly assign subjects to conditions. Although prospective designs are considered to be more rigorous with less biased sample selection and better measurement of the natural history of a phenomenon (Sedgwick, 2013), much of what we know about the long-term effects of childhood maltreatment comes from retrospective studies (Norman et al., 2012). Retrospective studies are less expensive and more time-efficient than prospective studies (Sedgwick, 2013). In addition, in the most ethical way, studying maltreatment prospectively will require intervention, which will influence the outcome of interest. The current dissertation comprises a multigenerational family study with a retrospective design. Although this design did not allow to study child maltreatment longitudinally, it enabled us to examine the effects of maltreatment across three generations and over the course of decades of development.

Intergenerational transmission of child maltreatment

Although child maltreatment is multiply determined (e.g., Stith et al., 2009), parents' own history of child maltreatment is widely discussed as a key risk factor for maltreatment of one's own children. Recent meta-analytical evidence indeed demonstrates that child maltreatment is transmitted across generations (Madigan et al., 2019). Nevertheless, estimates of intergenerational transmission of child maltreatment (ITCM) vary widely between studies likely due to sampling strategy, variations in design (e.g., retrospective vs. prospective), source of maltreatment reports (e.g., official records vs. parent or child reports) and type of maltreatment under investigation (e.g., abuse vs. neglect). In Chapter 2, we address one methodological aspect of ITCM which has not received much attention: the use of single-informant vs. multi-informant approaches. The aim of this study was to empirically test ITCM using multiple sources of information, i.e., mothers, fathers and children. In addition, we compared this multi-informant approach to two common approaches: ITCM using the perspective of one reporter and ITCM using the perspectives of different reporters from each generation.

Mechanisms of ITCM

Even when rates of ITCM can be more rigorously estimated, what is arguably most important are the mechanisms involved in ITCM (Alink, Cyr, & Madigan, 2019; Egeland et al., 2002). Better understanding of such mechanisms can inform interventions designed to break the cycle of abuse and neglect. One mechanism that might play a role in ITCM is the ability to process social information effectively. Dykas and Cassidy (2011) propose that individuals process social information in accordance with their attachment-related experiences. Secure individuals draw on their positive attachment-related experiences and process social information in a positively biased manner, whereas insecure individuals process attachment-relevant social information in a negatively biased manner. Indeed, empirical

findings reveal that parents who received harsh parenting and emotional rejection during their childhood make more negative attitudes about their child's behavior (Daggett, O'Brien, Zanolli, & Peyton, 2000; Leerkes & Siepak, 2006). Negative and hostile interpretations of child signals, in turn, have been associated with maltreating behavior of parents towards their children (Bauer & Twentyman, 1985; Crouch, Skowronski, Milner, & Harris, 2008).

In addition to cognitive-affective processes, the ability to regulate behavior has been examined in relation to experienced and perpetrated maltreatment. For example, a handgrip dynamometer has been used to assess the use of excessive force in pseudo-parenting contexts. One study found that maltreating mothers used excessive force more often while listening to infant cry and laughter sounds than non-maltreating mothers (Compier-de Block et al., 2015), indicating that an inability to modulate behavioral responses to infant emotional signals puts parents at risk for maltreating their children. Although the use of excessive force has not yet been investigated as a function of parents' childhood maltreatment history, it has been shown that adults with insecure attachment representations used more excessive force when listening to infant crying than individuals with secure representations (Riem, Bakermans-Kranenburg, van IJzendoorn, Out, & Rombouts, 2012). This suggests that negative attachment experiences pose a risk factor for the modulation of handgrip force. We examine this proposition in Chapter 3, where we investigate the associations between parents' experiences of childhood maltreatment and their handgrip force when exposed to infant cry and laughter sounds.

Evidence so far of the role of parents' childhood maltreatment history in their behavioral responses comes from studies observing real-time parent-infant interactions. Findings of a systematic review of observational studies on childhood abuse history and mother-infant interactions, revealed that childhood abuse experiences were associated with maternal hostile, intrusive, and inconsistent behavior towards infants (Vaillancourt, Pawlby, & Fearon, 2017). Similar conclusions have been reached in studies including parent-offspring interactions with offspring during later developmental stages (toddlerhood and middle childhood, e.g., Bailey et al., 2007) but studies with offspring beyond middle childhood are – to our knowledge – lacking. With regard to perpetrated child maltreatment, observational studies found that maltreating parents showed more aversive and less positive behavior than non-maltreating parents during interactions with their children (Wilson et al., 2008), indicative of behavioral regulation problems in maltreating parents. Yet, again, studies including parent-offspring interactions with offspring beyond middle-childhood are scarce or even lacking. In Chapters 4 and 5 we, therefore, examined the associations between maltreatment (experienced and perpetrated) and parent-offspring interactions with offspring across a wide developmental age range.

On a psychophysiological level, dysregulation of the autonomic nervous system (ANS) has been posited as a mechanism of ITCM. A history of child maltreatment may cause lasting disruptions of the ANS, which in turn may serve as a risk factor for maltreating one's own

offspring. When it comes to responding to infant crying, parents from the general population have been found to respond with increased ANS activity (e.g., Del Vecchio, Walter, & O'leary, 2009). This response is functional because ANS activation facilitates a behavioral caregiving response by mobilizing the body. However, it has been hypothesized that when the ANS response is too strong, i.e., *hyper*-reactivity, or too weak or even absent, i.e., *hypo*-reactivity, it may lead to abusive and neglectful caregiving, respectively (Reijman et al., 2014). A review concluded that autonomic reactivity is, indeed, a risk factor for child (physical) maltreatment (McCanne & Hagstrom, 1996). Because only a few samples included neglectful parents, subgroups might have been too small to detect differential autonomic reactivity patterns in abusive and neglectful parents. A recent meta-analysis, however, found no differences between maltreating/at risk and non-maltreating/low risk parents in terms of autonomic reactivity, but (risk for) child maltreatment was found to be associated with higher baseline autonomic activity, indicative of chronic cardiovascular *hyper*-arousal (Reijman et al., 2016). Contrary to ANS reactivity to stressful stimuli, chronic ANS activation may more generally represent the capacity to regulate emotions (Appelhans & Luecken, 2006).

To date, only two studies have examined parents' childhood maltreatment experiences in relation to their ANS reactivity to child emotional signals (Casanova et al., 1994; Reijman et al., 2014). Both studies found differential ANS reactivity to infant emotional signals depending on childhood maltreatment history. Yet, empirical research on the link between parents' childhood maltreatment history and their ANS reactivity in the context of real-time parent-offspring interactions with offspring beyond infancy is lacking. This represents a research gap, because measuring ANS activity during real-time parent-offspring interactions may provide insight into the mechanisms underlying the effects of childhood maltreatment experiences on parenting behavior. In Chapter 4 we address this gap by exploring whether the association between parents' childhood maltreatment experiences and their parental behavior is mediated by their autonomic reactivity.

Finally, besides processes on the individual level, processes on the family level may play a role in ITCM. The majority of research on child maltreatment is guided by the idea that maltreatment stems from individual pathology (Stith et al., 2009). Nonetheless, child maltreatment occurs in a family context, hence, family-level factors should also be taken into account. Belsky's ecological framework (1980) conceptualizes child maltreatment as multiply determined by factors at the level of the parent (ontogenic development), the family (the microsystem), the community (the exosystem), and the cultural environment (the macrosystem) in which the individual and the family are embedded. The interactions of factors within and across ecological systems determine whether child maltreatment occurs. Family conflict and low family cohesion have been shown to be risk factors for child maltreatment (Stith et al., 2009), and therefore may also play a role in ITCM. In Chapter 5 of the current dissertation, family cohesion was observed to examine the role of the family system in child maltreatment.

In conclusion, several mechanisms of ITCM have been proposed and examined in relation to either experienced or perpetrated maltreatment. Nonetheless, few studies have examined mechanisms at multiple levels of functioning at the same time, limiting our understanding of how these mechanisms are interrelated. Moreover, both abuse and neglect have been shown to compromise adaptive development, but up to now it remains unclear whether abuse and neglect differentially affect behavioral and biological systems (Gunnar & Quevedo, 2007). Finally, few studies have included fathers, despite the fact that fathers' involvement in childcare has continuously increased the past few decades (Jones & Mosher, 2013; World Health Organization, 2007), or examined parenting behavior in the context of the family and across a wide developmental age range. The current dissertation addresses these gaps in the literature, and comprises three studies (Chapter 3-5) aimed at improving our understanding of the mechanisms of ITCM. To do so, we zoomed in on essential aspects of these mechanisms, that is, we examined whether processes at multiple levels of functioning are either associated with experienced or perpetrated maltreatment (abuse and neglect). In Chapter 3, we examine whether parents' experiences of childhood maltreatment are associated with their cognitive-affective, behavioral and autonomic responses to infant emotional signals. In Chapter 4, we investigate the associations between parents' history of childhood maltreatment and their behavioral and autonomic responses while discussing conflict with their offspring. Finally, in Chapter 5, the associations between child maltreatment, dyadic parent-offspring interactions and family cohesion are examined.

The 3-Generation Parenting Study

The current dissertation is based on an empirical study with an extended family design: The 3-Generation (3G) Parenting Study (see also Compier-de Block et al., 2017). The 3G Parenting Study is a cross-sectional three-generational extended family study examining the interplay of methodological (e.g., reporter effects), genetic, and environmental factors involved in the intergenerational transmission of parenting styles, stress and emotion regulation. Mechanisms of (intergenerational transmission of) child maltreatment were operationalized at multiple levels: genetic, neurological (brain morphology and activity), physiological (autonomic and hormonal), behavioral and the level of family environment.

In order to increase power, we oversampled individuals with experienced maltreatment by recruiting target participants from three participant pools: (1) The Netherlands Study of Depression and Anxiety (NESDA; Penninx et al., 2008), (2) the Longitudinal Internet Studies for the Social Sciences (LISS panel; Scherpenzeel & Toepoel, 2012) and (3) a study on parenting (Joosen, Mesman, Bakermans-Kranenburg, & van IJzendoorn, 2013). From two of these studies, maltreatment information was available and only participants with a known history of maltreatment were asked to participate in the 3G Parenting Study. From the third study, all participants were invited. Participants were sent a flyer about the study, and were

subsequently contacted by phone. If a participant (target) agreed to take part in the study, and gave permission to approach family members, then family members of this target participant and their partner were also invited to participate (parents, children, siblings (and their partners), nieces, and nephews). Figure 1.1 depicts a family tree of participants from three generations (F1, F2 and F3) invited around the target participant. Family members had to be at least 7.5 years of age to be included. Families were included if at least two first-degree relatives from two generations agreed to participate. In advance, participants were informed about the general aim of the study (which was formulated as the role of genes and parenting in the intergenerational transmission of stress-related traits) and about the procedure of a lab visit. Data was collected between March 2013 and May 2016.

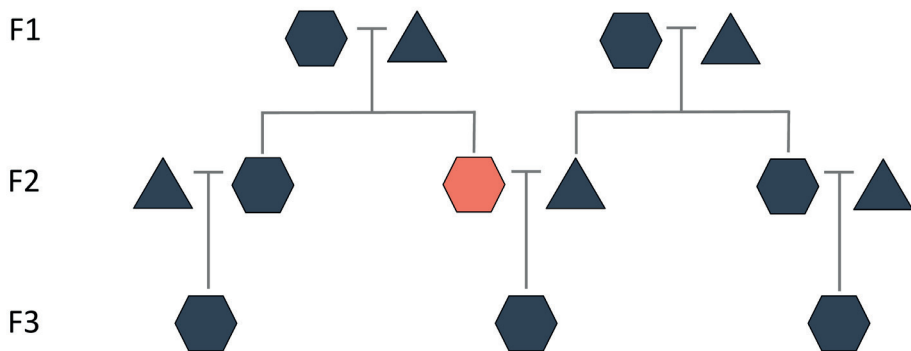


Figure 1.1

Family tree of participants invited around target (in red).

Focus and outline of the dissertation

The overall aim of the current dissertation is to gain more insight into the etiology and sequelae of child maltreatment by using a multidimensional multi-method investigation in extended families. A graphic representation of the topics discussed in this dissertation is presented in Figure 1.2. In the first part of this dissertation, Chapter 2, we examine if child maltreatment is transmitted across generations (ITCM), with a central focus on the role of reporter effects in this transmission. In Chapters 3-5 we zoom in on antecedents and consequences of child maltreatment that might play a role in ITCM, and examine these in several (pseudo-)parenting contexts. In Chapter 3, we investigate whether parents' childhood maltreatment experiences are associated with their cognitive, behavioral and autonomic responses to infant emotional signals, using a standardized infant vocalizations paradigm (see Compier-de Block et al., 2015). In Chapter 4, we focus on parents' childhood maltreatment experiences and their behavioral and autonomic responses during a parent-offspring conflict interaction task (See Strodtbeck, 1951). Finally, in Chapter 5, we present a

study in which we investigate the associations between child maltreatment, family cohesion (observed during a playful tower building game) and dyadic parent-offspring interactions.

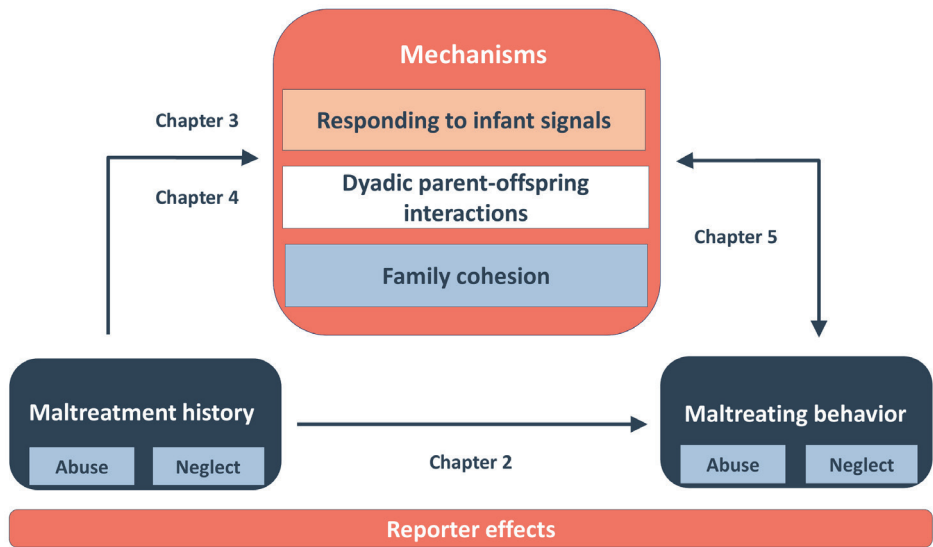


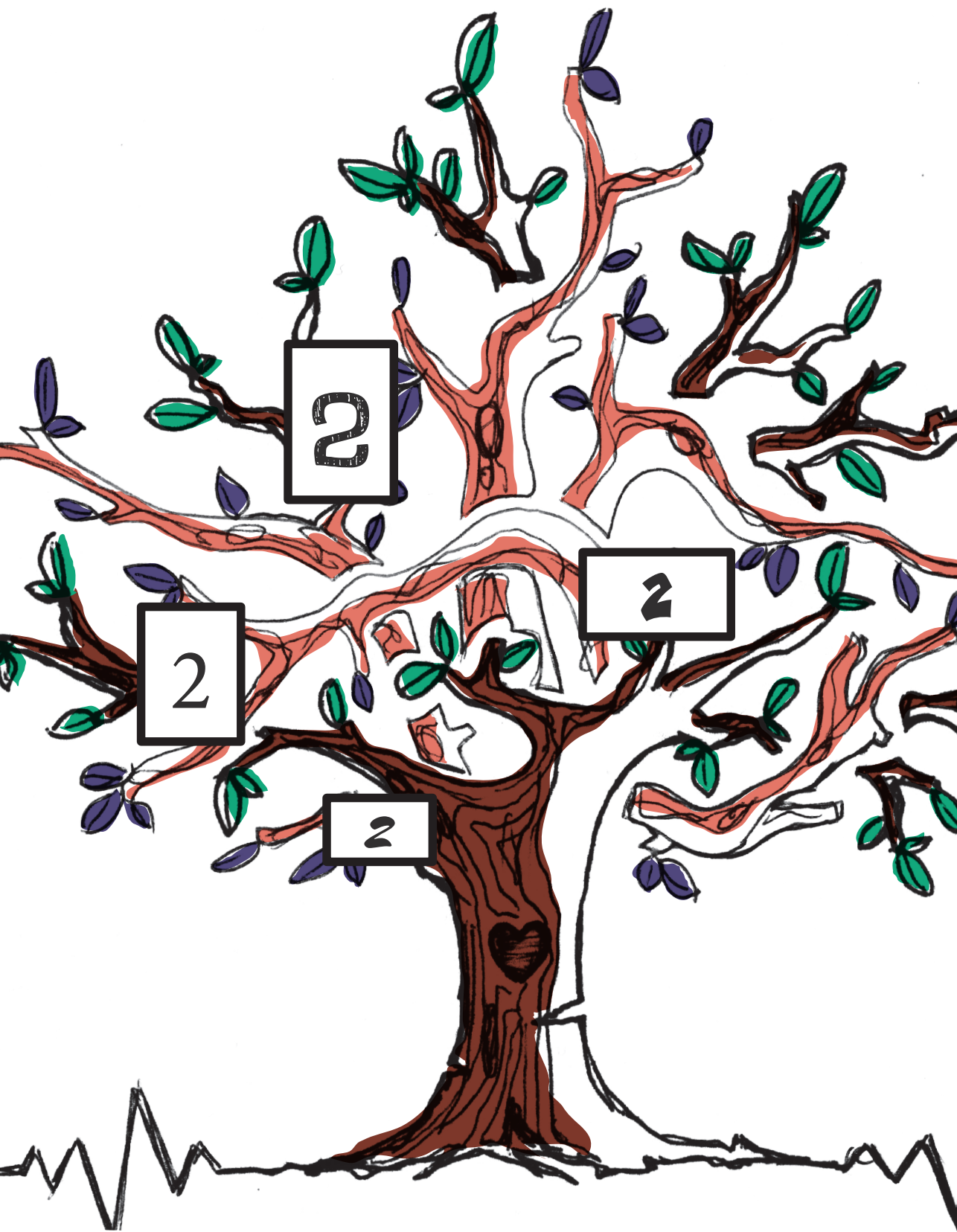
Figure 1.2

Graphic representation of the topics discussed in the current dissertation. Note that not the overall model is tested, rather we examined its parts. In Chapter 2, we examine the role of reporter effects in the intergenerational transmission of child maltreatment. In Chapter 3, we investigate the associations between parents' experiences of childhood maltreatment and their perceptual, behavioral and autonomic responses to infant emotional signals. Chapter 4 focuses on parents' childhood maltreatment experiences and their behavioral and autonomic responses while discussing conflict with their offspring. Chapter 5 presents a study in which we investigate the associations between child maltreatment, dyadic parent-offspring interactions and family cohesion.

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2

Chapter 2

Intergenerational transmission of child maltreatment using a multi-informant multi- generation family design

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Abstract

In the current study a three-generational design was used to investigate intergenerational transmission of child maltreatment (ITCM) using multiple sources of information on child maltreatment: mothers, fathers and children. A total of 395 individuals from 63 families reported on maltreatment. Principal Component Analysis (PCA) was used to combine data from mother, father and child about maltreatment that the child had experienced. Herewith, we created components reflecting the convergent as well as the unique reports of father, mother and child on the occurrence of maltreatment. Next, we tested ITCM using the multi-informant approach and compared the results to the outcomes based on two more common approaches: ITCM based on one reporter and ITCM based on different reporters from each generation. Results from our multi-informant approach showed that a component reflecting convergence between mother, father, and child reports explained most of the variance in experienced maltreatment. For abuse, intergenerational transmission was consistently found across approaches. In contrast, intergenerational transmission of neglect was only found when analyses were based on the perspective of a single reporter, indicating that transmission of neglect might be driven by reporter effects. In conclusion, the present results suggest that including multiple informants may be necessary to obtain more valid estimates of ITCM.

Keywords: Intergenerational transmission, child maltreatment, multiple informants

Introduction

What puts parents at risk to maltreat their children? This is a question that has been the subject of research for several decades (e.g., Altemeier, O'Connor, Sherrod, & Tucker, 1986; Egeland, Jacobvitz, & Sroufe, 1988). One prevailing hypothesis is that child maltreatment is passed down through family trees, moving from one generation to the next. This notion has been approached from multiple, albeit different, theoretical perspectives, including social-learning (Bandura, 1977), developmental psychopathology (Jaffee, 2017), and attachment theory (Bowlby, 1969). However, the empirical evidence for intergenerational transmission of child maltreatment (ITCM) has been mixed. Although ITCM was found in some studies (e.g., Berlin, Appleyard, & Dodge, 2011; Dixon, Browne, Hamilton-Giachritsis, 2005; Pears & Capaldi, 2001), other researchers have found no evidence for transmission (e.g., Altemeier, O'Connor, Sherrod, Tucker, & Vietze, 1986; Renner & Slack, 2006; Sidebotham, Golding, & the ALSPAC Study Team, 2001). Overall, meta-analytic evidence suggests that there is ITCM but that effect sizes are modest (Madigan et al., 2019).

These mixed results can be partly attributed to variations in design (e.g., retrospective vs. prospective), population and sampling strategy (e.g., at risk vs. representative sample), and source of maltreatment reports (e.g., official records vs. child or parent report). One methodological aspect of ITCM which has not received much attention is the use of single informant vs. multi-informant approaches. Multi-informant approaches offer advantages over single informant approaches such as reducing error and individual bias (Kraemer et al., 2003). In the current study we apply a multi-generational family design to compare estimates of ITCM using single informant approaches with a multi-informant approach. A multi-generation family design offers opportunities to address specific ITCM issues. So far, few studies have employed this kind of design, possibly because such studies are methodologically complex and recruiting families, compared to individual participants, is clearly more challenging. Using a one-generational design, ITCM can be tested by asking the participants (G2) about any maltreatment they have experienced and any maltreatment they have perpetrated (see Figure 2.1, Design 1). However, this approach is vulnerable to overestimation of transmission if a common factor, e.g., recall bias, affects both the report on experienced maltreatment and the report on perpetrated maltreatment. One way to prevent this is to use a two-generational design by including a second generation. In that case, participants from both generations report whether they have experienced childhood maltreatment. This design is stronger but it cannot be extended to include multiple reporters of maltreatment experienced by the parent (G2, see Figure 2.1, Design 2). By extending this design vertically (by including additional generations) and horizontally (multiple siblings, nephews, nieces etc.), estimates can be based on multiple reporters, as it is possible to include reports from both parents and multiple children both about experienced and perpetrated maltreatment. Reporter bias

can thus be reduced by including three participating generations (Figure 2.1, Design 3). Moreover, several siblings can report on the maltreatment perpetrated by the same parent giving a more comprehensive picture of parents' behavior. The 3G Parenting Study utilized a multi-informant multigenerational cross-sectional extended family study design. The aim of the current paper is to empirically test ITCM using this design while also addressing reporter effects.

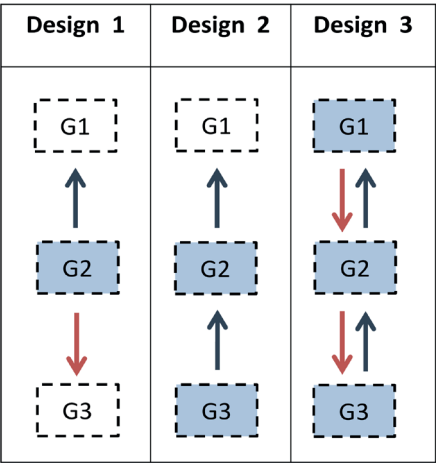


Figure 2.1
Three designs to test intergenerational transmission of child maltreatment (ITCM) were used: (1) One informant reports on experienced and perpetrated maltreatment (G2, in blue), (2) Informants from two generations (G2 and G3) report about experienced maltreatment, and (3) Informants from three generations report about experienced and perpetrated maltreatment (G1, G2, and G3). G1 = Generation 1; G2 = Generation 2; G3 = Generation 3; Blue arrow = child report; Red arrow = parent report.

Intergenerational transmission using multiple informants

Studies on ITCM have almost exclusively used self-report to measure experienced and perpetrated maltreatment in parents, with a few exceptions that used official reports (e.g., Thornberry, Knight, & Lovegrove, 2012). Parents may however underreport perpetrated maltreatment because of social stigma and legal consequences (Knight, Runyan, Dubowitz, Brandford, & Kotch, 2000). Conversely, children may underreport experienced maltreatment for various reasons, including loyalty to their parents or fear of punishment (Della Femina, Yeager, & Lewis, 1990; Jouriles, Mehta, McDonald, & Francis, 1997). In addition, both parent and child reports may be biased due to distorted memories (Edwards et al., 2001), or due to their subjective appraisals of certain experiences, or lack of experiences, as in the case of neglect (Smith, Ireland, Thornberry, & Elwyn, 2008). These biases can be alleviated by including different perspectives. This however creates new

challenges, particularly if these perspectives differ. In most cases, there are no theoretical or empirical reasons to prioritize one reporter over the other and there is no singularly right way to combine several reports.

Convergence between parent-reported and child-reported incidence of maltreatment is generally low to moderate (Chan, 2012, 2015; Compier- de Block et al., 2016). Nonetheless, precisely this divergence makes it important to include several reporters, since different reports may lead to different conclusions (Kobulsky, Kepple, Holmes, & Hussey, 2017) and because the meaning of differences between reporters is not well understood (Laird & Weems, 2011). A better understanding of reporter effects also has important practical implications. Professionals involved in decision making about interventions in case of maltreatment (including out-of-home placements) often take into account the reports of parents and children in their decision making (Gilbert et al., 2009). Understanding the implications of parent-child convergence and divergence may help professionals to make better decisions.

Reporter effects may play a considerable role in ITCM. For instance, a prospective cohort study examined ITCM in a sample of maltreatment victims confirmed by Child Protective Services (CPS) and a matched comparison group (Widom, Czaja, & DuMont, 2015). Parent report, child report and reports from CPS as measures of perpetrated maltreatment were compared. A complex pattern of ITCM emerged indicating that transmission depended on reporter and type of maltreatment. Support for the transmission of neglect was found irrespective of the reporter. There was transmission of sexual abuse when perpetrated maltreatment was measured using CPS records and child report but not parent report. However, transmission of physical abuse was only detected using CPS records. The authors concluded that “the extent of the intergenerational transmission of abuse and neglect depend[s] in large part on the source of the information used to assess maltreatment” (Widom et al., 2015, p. 1484). To further understand and interpret this finding, in the current study we included multiple sources of information on (experienced and perpetrated) abuse and neglect, i.e., mothers, fathers and children, and tested various models to examine ITCM.

An alternative approach of integrating different reports

Currently no gold standard exists on how to combine information from different informants. It has been proposed to average the scores of different informants (Achenbach, 1995; Piacentini, Cohen, & Cohen, 1992). However, this approach does not enhance our understanding of differences between reporters. Others have argued that scores of different informants can best be analyzed separately when the level of agreement between informants is low (Hambrick, Tunno, Gabrielli, Jackson, & Belz, 2014; Offord et al., 1996). A limitation of this strategy is that results obtained from models with different informant scores may be inconsistent and challenging to interpret. Findings are tied to a specific informant and therefore difficult to generalize. Other approaches – which are common in psychiatric

research but may also be used in child maltreatment research – are to combine information from each source with the “OR” rule, classifying the condition as present when reported by at least one informant, or the “AND” rule, classifying the condition as present when reported by all informants (Kraemer et al., 2003). The disadvantage of both approaches, however, is that valuable information could be overlooked, since more often than not parents and children have different perspectives which may both be valid to some extent (Shaffer, Huston, & Egeland, 2008; Tajima, Herrenkohl, Huang, & Whitney, 2004). Moreover, these approaches rely on dichotomies, whereas continuous scores may provide important information on the variance in extent, severity, and chronicity of child maltreatment.

In the present study we therefore used an alternative method, originally proposed by Kraemer and colleagues (2003), to integrate data from multiple informants. This method combines the reports of different informants, while simultaneously taking their concordance and discordance into account, therewith allowing a thorough study of reporter effects. Kraemer and colleagues (2003) devised this method to deal with inter-informant discordance in psychiatric assessments, where none of the individual perspectives are sufficiently precise and accurate. In their approach, inter-informant discordance is not regarded as measurement error that needs to be eliminated, but rather as adding information on underlying perspectives and contexts of data obtained. A Principal Component Analysis (PCA) approach is used to disaggregate informant ratings into different sources of variability, namely the shared (i.e., convergent) view, and the unique (i.e., independent) perspectives of each informant. Sierau and colleagues (2017) applied this factor-analytic approach to the measurement of child maltreatment, and established three components in their study: the shared variance between sources on the occurrence of maltreatment (convergence), non-shared variance resulting from the child’s own perspective, and the parent versus CPS perspective.

Applied to our study, we aimed to establish components reflecting the convergent as well as the unique (discordant) reports of father, mother, and child on the occurrence of maltreatment. We employed a data-driven approach, using principal component analyses (PCA), to integrate data on maltreatment from different informants – father, mother and child, allowing for unknown or unexpected patterns of inter-informant concordance and discordance. Subsequently, ITCM was tested by using the extracted convergence and discordance components as predictors of perpetrated maltreatment in a linear model. To compare the results of this approach to more conventional approaches, ITCM was also estimated using the perspective of one reporter and the perspective of different reporters from each generation:

1. Based on theoretical and empirical evidence, we expect that ITCM will be found for maltreatment when using a one-generational design (Figure 2.1, Design 1), i.e., one informant reports about both experienced and perpetrated maltreatment.

2. Based on theory, we expect ITCM when informants from two generations report on experienced and perpetrated maltreatment (Figure 2.1, Design 2), but empirical evidence is mixed.
3. Based on theory, we expect ITCM when informants from three generations report on experienced and perpetrated maltreatment (Figure 2.1, Design 3), but empirical evidence is lacking.

Additionally, we explored the role of divergent reports in ITCM. Lastly, different patterns of ITCM for abuse and neglect were explored. It has been argued that experiences of threat, such as abuse, and experiences of deprivation, such as neglect, affect development differently (Sheridan & McLaughlin, 2014), but it is unclear what implications this has for the intergenerational transmission. In all analyses we, therefore, distinguished between abuse and neglect.

Method

Sample

Recruitment

The 3G Parenting Study is a cross-sectional three-generational extended family study on the interplay of methodological (e.g., reporter effects), genetic, and environmental factors involved in the intergenerational transmission of parenting styles, stress and emotion regulation. We operationalized mechanisms of (intergenerational transmission of) child maltreatment at multiple levels: behavioral, physiological (autonomic and hormonal), neurological (brain morphology and activity), and with quantitative and molecular genetics.

In order to increase power to detect intergenerational transmission of child maltreatment, we oversampled for experienced maltreatment by recruiting target participants from three participant pools: (1) The Netherlands Study of Depression and Anxiety (NESDA; Penninx et al., 2008), (2) the Longitudinal Internet Studies for the Social Sciences (LISS panel; Scherpenzeel & Toepoel, 2012) and (3) a study on parenting (Joosen, Mesman, Bakermans-Kranenburg, & van IJzendoorn, 2013). From two of these studies, maltreatment information was available and only participants with a known history of maltreatment were asked to participate in the 3G Parenting Study. From the third study, all participants were invited. In order to protect the privacy of our participants we cannot disclose from which study we recruited maltreated participants. Participants were sent a flyer about the study, and were subsequently contacted by phone. If a participant agreed to take part in the study, then with permission family members of this participant and their partner were also invited to participate (parents, children, siblings (and their partners), nieces, and nephews). Family members had to be at least 7.5 years of age to be included. Families were included if at

least two first-degree relatives from two generations agreed to participate. In advance, participants were informed about the general aim of the study (which was formulated as the role of genes and parenting in the intergenerational transmission of stress-related traits) and about the procedure of a lab visit. Data was collected between March 2013 and May 2016.

Sample characteristics

In the 3G Parenting Study 63 families of 395 individuals from four generations participated (Figure 2.2), with an average of 6.27 family members per family (range: 2 to 23). The first generation (G1) consisted of 60 participants (63% female, $M_{\text{age}} = 68.92$ years, $\text{range}_{\text{age}} = 53.25$ to 88.42 years) and reported about maltreatment experienced at the hands of their parents ("G0", father and mother separately) and about maltreatment perpetrated towards the second generation (G2). In the second generation (G2) 186 participants were included (57% female, $M_{\text{age}} = 45.98$ years, $\text{range}_{\text{age}} = 21.17$ to 69.67 years) and reported about maltreatment experienced at the hands of their parents (G1, father and mother separately) and about maltreatment perpetrated towards their children (G3). The third generation (G3; $n = 146$, 55% female; $M_{\text{age}} = 17.97$ years, $\text{range}_{\text{age}} = 7.50$ to 47.50 years) reported about maltreatment experienced at the hands of their parents (G2, father and mother separately). In a minority of cases G3 had children and reported about perpetrated maltreatment towards their children (G4; $n = 16$). Three G4 participants were included in the current study and reported about maltreatment perpetrated by G3 (father and mother separately). We used Analysis of Covariance (ANCOVA) to compare participating fathers (G1 and G2, $n = 164$) to fathers who were eligible but did not participate ($n = 78$) on perpetrated abuse (child report). We controlled for child age and gender. Based on child report, participating fathers perpetrated more abuse than fathers who did not participate ($F(1, 238) = 7.67, p < .01$). Conversely, fathers who did not participate were reported to be more neglecting ($F(1, 238) = 25.53, p < .001$). Similarly, participating mother ($n = 202$) were reported to perpetrate more abuse than non-participating mothers ($n = 55$; abuse: $F(1, 253) = 5.69, p = .02$) but less neglect ($F(1, 253) = 4.30, p = .04$). Of the adult participants (≥ 18 years, $n = 302$) 6% completed elementary school, 19% lower vocational school, 40% completed advanced secondary education, and 28% had a college or university degree (6% unknown). The sample was rather homogenous in terms of ethnicity: 96% of the participants were Caucasian.

Procedure

Participants and their families were invited to the lab for one or two days, depending on family composition. Participants from the second and third generation with children visited the lab once with their nuclear family and once with their family of origin. In some cases family members attended the lab sessions separately for practical or personal reasons.

During the lab visits, participants individually completed questionnaires and computer tasks, and did several interaction tasks together with their family members. During some of the tasks heart rate and skin conductance were measured (see also Buisman et al., 2018). To measure hormone levels and DNA saliva, hair, and buccal samples were collected. Eligible participants were also invited for a functional magnetic resonance imaging (fMRI) session (see also van den Berg et al., 2018). Questionnaires on child maltreatment were completed during the first visit. Since all participants with children completed at least two of these questionnaires (one on experienced and one on perpetrated maltreatment), these questionnaires were scheduled as far apart as possible. The study was approved by the ethics committee of the Leiden University Medical Centre (reference number: P11.134). Written informed consent was obtained from all participants before participation. For participants under 18 years of age, parents cosigned informed consent. As a compensation for participation, adults received 50 Euros for one lab visit and up to 100 Euros (depending on time investment) for two lab visits, as well as travelling expenses.

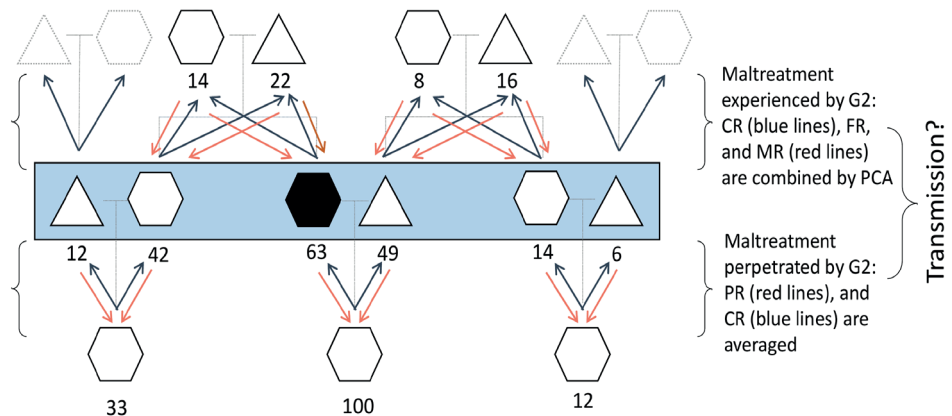


Figure 2.2

Summary family tree of participants. Black hexagon = Target participant (recruited first); Dotted symbols: Children reported about these parents but parents were never invited to the lab; Red arrow = Reports of perpetrated maltreatment. Blue arrow = Reports of experienced maltreatment. CR = Child report; FR = Father report; MR = mother report; PR = Parent report. Five participants were omitted from this diagram for simplicity: One partner from the third generation (G3) and four participants from the fourth generation.

Ethical considerations

In the Netherlands, the Protocol Reporting Code Domestic Violence and Child Abuse applies. This means that if a child under 18 years of age reports maltreatment, individuals working in health care, child or youth care, education, social support, and criminal justice are obligated to make a report. After every lab visit with children under 18 years, one of the first authors of this paper checked the parent and child reported maltreatment questionnaires. Relevant cases were (anonymously) reviewed by the research team (including senior researchers with clinical experience). In cases where current moderate to severe child maltreatment was suspected a senior psychologist discussed the case with a clinical psychologist of a specialized center for psychological trauma. If the family was not under legal or clinical guidance already, the local Advice and Reporting Centre for Child Abuse and Neglect (*Veilig Thuis*) was subsequently contacted. In accordance with the recommendation from this Centre one of the following steps were taken: (1) no action, (2) the family was contacted to gain further information, or (3) a report was filed and appropriate action was taken by the Advice and Reporting Centre for Child Abuse and Neglect. Ultimately, the Advice and Reporting Centre for Child Abuse and Neglect was contacted about three families.

Measures

Child maltreatment

Experienced and perpetrated child maltreatment were measured using a combination of the Parent-Child Conflict Tactics Scales (CTS-PC; Straus, Hamby, Finkelhor, Moore, & Runyan, 1998) and the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994; Thombs, Bernstein, Lobbestael, & Arntz, 2009) .

The CTS-PC originally consists of four scales. However, we excluded the *Nonviolent Discipline* scale (4 items), because it does not include items on maltreatment. The *Psychological Aggression* scale (i.e., emotional abuse), consisting of 5 items, assesses verbal or other nonphysical communication aimed at inflicting psychological pain or fear to the child (e.g., “Shouted, yelled, or screamed”). *Physical Assault* (i.e., physical abuse) is comprised of 13 items, including corporal punishment (5 items, e.g., “Spanked on the bottom with a bare hand”), severe assault (4 items, e.g., “Hit with a fist or kicked hard”), and very severe assault (4 items, e.g., “Burned or scalded”). The *Neglect* scale consists of 5 items and measures the failure of a parent to engage in behavior that is necessary to meet the developmental needs of a child (e.g., “My father/mother was not able to make sure I got the food I needed”). Since the *Neglect* scale includes only one item on emotional neglect (“My father/mother never told me he/she loved me”), we added five items of the *Emotional Neglect* scale of the CTQ, reverse coded for the purpose of analysis. To match the response categories of the CTS and CTQ, we used a 5-point scale ranging from 1 = *never* to 5 = *almost always* for all items.

Participants completed a version that assessed the extent to which they had experienced specific physically or psychologically neglectful or aggressive behaviors from their father and/or mother before the age of 18 years. Participants with children reported the extent to which they had conducted these behaviors towards (each of) their child(ren). For participants under 12 years of age, experienced maltreatment was assessed orally and questions about very severe physical abuse were omitted. Participants aged 12-18 years and living with their parents at the time of the study indicated whether they had experienced maltreatment within the last year or in the years before. Per item, the higher score of these two was included in all calculations. Subscale scores based on the higher score correlated significantly with subscales based on either last year (range: $r(47) = .40 - .88$) or the years before (range: $r(46) = .86 - .99$). For participants aged 18 years or older, lifetime maltreatment (until 18 years) was assessed.

Internal consistencies of the scales for experienced maltreatment were as follows: for physical abuse $\alpha_{\text{mother}} = .92$ and $\alpha_{\text{father}} = .92$, for emotional abuse $\alpha_{\text{mother}} = .78$ and $\alpha_{\text{father}} = .73$, for physical neglect $\alpha_{\text{mother}} = .65$ and $\alpha_{\text{father}} = .57$ and for emotional neglect $\alpha_{\text{mother}} = .91$ and $\alpha_{\text{father}} = .89$. Internal consistencies of the scales on perpetrated maltreatment were: for physical abuse $\alpha_{\text{child1}} = .71$ and $\alpha_{\text{child2}} = .76$, for emotional abuse $\alpha_{\text{child1}} = .69$ and $\alpha_{\text{child2}} = .66$, for physical neglect $\alpha_{\text{child1}} = .38$ and $\alpha_{\text{child2}} = .36$ for, and for emotional neglect $\alpha_{\text{child1}} = .69$ and $\alpha_{\text{child2}} = .67$. We initially aimed to distinguish these four types of maltreatment. However, internal consistencies for the four items on physical neglect were not sufficient and the physical abuse and the physical neglect scale were both highly skewed to the right. We therefore decided to combine the physical and emotional scales. Internal consistencies of these combined scales were as follows: for experienced abuse $\alpha_{\text{mother}} = .92$ and $\alpha_{\text{father}} = .92$, for experienced neglect $\alpha_{\text{mother}} = .86$ and $\alpha_{\text{father}} = .85$, for perpetrated abuse $\alpha_{\text{child1}} = .82$ and $\alpha_{\text{child2}} = .81$, and for perpetrated neglect $\alpha_{\text{child1}} = .62$ and $\alpha_{\text{child2}} = .61$. Occurrence of maltreatment is reported in Table S2.1 and Table S2.2 in the Supplementary material.

To create an *experienced* maltreatment score, for child and parent report, four scale scores (*Emotional Abuse*, *Physical Abuse*, *Emotional Neglect* and *Physical Neglect*) were calculated from participants' self-reported experienced maltreatment and from mother and father self-reported perpetrated maltreatment towards that particular participant. For participants' self-reported maltreatment (i.e., child report), scale scores were comprised of the highest score for father or mother (e.g., the highest score of *Emotional Abuse by father* or *Emotional Abuse by mother* was used for the score on the scale *Emotional Abuse*). Next, an overall *Abuse* score was comprised by averaging Emotional and Physical Abuse, and an overall *Neglect* score was comprised by averaging Emotional and Physical Neglect. The same scale scores were computed separately for mother and father self-reported perpetrated maltreatment towards that particular participant (i.e., parent report). This resulted in information from three informants to be combined for experienced maltreatment: father, mother and child score (highest score for father or mother).

To create a *perpetrated* maltreatment score for child and parent report, per scale and child, averages were computed. If multiple children reported on one parent or a parent reported on multiple children, the highest score per scale was included. We chose to combine the individual child reports, because a number of parents ($n = 34$) had one child. As a result, there were only two informants to be combined for perpetrated maltreatment.

Because the distribution of the CTS data was skewed to the right, scores were log-transformed and then multiplied by 10 to scale up the variance. There was one outlier ($n = 1$), which was winsorized, i.e., the difference between the two next highest values was added to the next highest value with standardized value < 3.29 (Tabachnick & Fidell, 2007) to fit the distribution.

Preparatory analyses

Multiple Imputation

Missing values were imputed by means of multiple imputation (MI) with the package ‘*mice*’ (van Buuren & Groothuis-Oudshoorn, 2011) in R (R Development Core Team, 2008). In MI, missing values are estimated several times, resulting in several complete versions of the incomplete dataset. Each of these datasets are then analyzed using the statistical procedure of interest, and the results are combined using specific combination procedures that take into account the variation of the imputed values in the standard errors and p -values. MI has the advantage that no information is thrown away, and that at the same time uncertainty of the missing data is taken into account in the statistical analysis (e.g., Van Buuren, 2012; Schafer, 1997; Rubin, 1987). The package ‘*mice*’ imputes incomplete multivariate data by chained equations (MICE; van Buuren & Groothuis-Oudshoorn, 2011). The data were imputed 50 times incorporating both predictors and auxiliary variables, i.e. variables that are not part of the model, but that are correlated with the variables in the model. Auxiliary variables were household chaos (Household Chaos questionnaire; Matheny, Wachs, Ludwig, & Phillips, 1995), number of siblings, non-verbal intelligence (Raven’s Standard Progressive Matrices; Raven, 2000), attachment styles (Experiences in Close Relationships Questionnaire (ECR-RS; Fraley, Heffernan, Vicary, & Brumbaugh, 2011), internalizing and externalizing problems (Child Behavioral Checklist (CBCL; Achenbach, 1991a), Youth Self Report (YSR; Achenbach, 1991b) & Adult Self Report (ASR; Achenbach & Rescorla, 2003), and eligibility (i.e., participated, declined or non-eligible). To improve our prediction model we included all participants from G2 and G3 to estimate experienced maltreatment, accumulating in a sample size of $n = 335$. Twenty percent of all values were missing (range: 0 to 54%). The majority of missing values were a result of one parent not participating. Self-report data on experienced maltreatment was complete. In 65% of the cases at least two reporters on maltreatment were available. In 40% of the cases three reporters on maltreatment were available, meaning that both parents participated.

We used predictive mean matching (PMM; Little, 1988) as multiple-imputation method. This method borrows an observed value from a donor with a similar predictive mean, so that imputed values never fall outside the range of the variable, or assume any other values that do not appear in the observed part of the variable. Autocorrelation function (ACF) plots revealed that all imputations converged (for a description of these plots see Azur, Stuart, Frangakis, & Leaf, 2011). In addition, the correlations between variables were approximately the same in the imputed datasets (see Table 2.2) compared to the non-imputed dataset (see Supplementary material Table S2.3). Further analyses were conducted in SPSS version 23.

Informant agreement

Intraclass correlations (ICCs) were calculated to determine concordance between mother report (MR), father report (FR), and child report (CR) for experienced maltreatment (see Supplementary material table S2.4).

Principal Component Analyses (PCA)

We then combined the different informants on experienced child abuse and neglect, by including father, mother and child scores in a principal component analysis (PCA; see Sierau et al., 2017, for a similar approach). Generalized Procrustes Analysis (GPA; Ten Berge, 1977, Gower, 1975) was used as a method to combine the results of PCA in multiple imputation (see van Ginkel & Kroonenberg, 2014 for a description of this method in the context of multiple imputation). In line with previous studies using a factor-analytic approach to disaggregate variance from different informants (Kraemer et al., 2003; Sierau et al., 2017), we set the number of factors to be extracted in the PCA equal to the number of informants (three in our case). The pooled component coefficients of each type of informant (mother/father/child) were then multiplied with the standardized original scores of each participant and summed up to obtain the component scores. The results of the PCA with three higher-order factor scores for experienced abuse and neglect are presented in Table 2.1. Note that mother and father report indicate self-reported perpetrated maltreatment towards the particular participant

Experienced abuse

For abuse, the first component – labeled *Reporter convergence* – showed high positive component loadings for all informants and indicates the convergent view of mother, father and child on the occurrence of abuse. This component explained 55% of the variance in the occurrence of abuse. The second component – *Mother report* – was defined by a high component loading for mother-reported abuse and negative component loadings for child- and father reported abuse. This component explained 24% of the variance in abuse. The third component was labeled *Father versus child report* because of a high

component loading for father reported abuse, a negative component loading for child reported abuse and a component loading close to zero for mother reported abuse. This component explained 20% of the variance in the occurrence of abuse.

Experienced neglect

For neglect, the first component – also labeled *Reporter convergence* – showed positive component loadings for all informants and indicates the convergent view of mother, father and child on the occurrence of neglect. This component explained 49% of the variance in the occurrence of neglect. The second component represented *Child report* since it was defined by a high positive component loading for child reported neglect and negative component loadings for mother reported and father reported neglect. This component explained 31% of the variance in the occurrence of neglect. The third component was interpreted as *Mother versus father report*, and showed a relatively high positive component loading for mother reported neglect, a negative loading for father report and a relatively low positive component loading for child reported neglect. This component explained 20% of the variance in neglect.

Perpetrated abuse and neglect

For perpetrated abuse and neglect there were only two informants (parents/children), which made PCA unnecessary. Component scores using a PCA on two items would give equivalent results as averaging the scores, since each item will get the same weight/loading in the PCA. Scores of parents and children were therefore averaged to create a perpetrated abuse and neglect score.

Table 2.1. Component loadings of the Principal Component Analysis (PCA) for maltreatment by multiple informants

Maltreatment	Component		
	Rep. convergence	Mother report	Father vs child report
Abuse			
Child report	0.76	-0.29	-0.58
Father report	0.75	-0.36	0.55
Mother report	0.72	0.69	0.04
Explained variance	55%	24%	20%
	Rep. convergence	Child report	Mother vs father report
Neglect			
Child report	0.51	0.84	0.21
Father report	0.81	-0.10	-0.57
Mother report	0.74	-0.47	0.49
Explained variance	49%	31%	20%

Note. Rep. = reporter

Intergenerational transmission of child abuse and neglect

First, we tested intergenerational transmission with two common approaches using stepwise multilevel modeling: a) intergenerational transmission from the perspective of one reporter: regression analyses with self-reported perpetrated maltreatment as dependent variable and self-reported experienced maltreatment as continuous predictor (Design 1, Figure 2.1) and b) intergenerational transmission from the perspective of different reporters from each generation: regression analyses with self-reported experienced maltreatment of G3 (as indicator of G2 perpetrated maltreatment) as dependent variable and self-reported experienced maltreatment of their parents (G2) as a continuous predictor (Design 2, Figure 2.1). Analyses were performed separately for abuse and neglect. In a next step, two stepwise multilevel models were conducted for the multi-informant scores of perpetrated abuse and neglect (for details see *Measures* section), with the PCA component scores of abuse and neglect as continuous predictors to determine whether a component explained additional variance in perpetrated abuse and neglect beyond variance explained by the other components (Design 3, Figure 2.1).

We used multilevel modeling to match the hierarchical structure of the data: individuals were nested within families. For every outcome we started with an unconditional means model- which decomposed the variance in the outcome measures into two independent components, σ_e^2 and σ_{v0}^2 (Model 1). This model was used to compute the intraclass correlation coefficient (ICC) at the family level ($\sigma_{v0}^2 / \sigma_{v0}^2 + \sigma_e^2$). Gender, age and household socio-economic status (SES) were subsequently added to the unconditional means model (Model 2). In the next step, perpetrate abuse or neglect were added (Model 3). Finally, the other type of maltreatment (i.e., abuse or neglect) was included in a last step to test whether the effects of abuse and neglect were unique (not displayed in the Tables). Pooled coefficients were provided by SPSS. We used the following formula to convert the unstandardized coefficients to standardized coefficients: $Beta_j = B_j * (SD(X_j) / SD(Y))$. Likelihood ratio tests were used to evaluate whether model fit improved.

Results

Descriptive statistics and correlations of study variables for the non-imputed study variables are presented in Table S2.3 in the Supplementary material. Correlations for imputed study variables are presented in Table 2.2. There was significant reporter correlation within experienced and perpetrated abuse and perpetrated neglect (range: $r(190) = .27 - .36, p < .05$). For experienced neglect, FR correlated with both CR ($r(190) = .24, p = .042$) and MR ($r(190) = .40, p = .001$) but CR and MR were not significantly correlated ($r(190) = .13, p = .171$). According to CR ($r(190) = -.17, p = .027$) and parent report (PR; ($r(190) = -.21, p = .004$), fathers were more neglectful than mothers. Experienced abuse ($r(190) = .20,$

Table 2.2. Correlations of the pooled observed variables

	Exp. Abuse CR	Exp. Abuse FR	Exp. Abuse MR	Perp. Abuse PR	Perp. Abuse CR	Exp. Neglect CR	Exp. Neglect FR	Exp. Neglect MR	Perp. Neglect PR	Perp. Neglect CR	Gender G2	Age G2
Exp. Abuse FR	.39**											
Exp. Abuse MR	.27**	.30*										
Perp. Abuse PR	.50**	.21*	.29**									
Perp. Abuse CR	.26**	-.05	-.03	.34**								
Exp. Neglect CR	.48**	.22	.09	.24**	.17*							
Exp. Neglect FR	.05	.10	.17	-.04	-.15	.24*						
Exp. Neglect MR	.03	.17	.34**	-.11	-.19	.13	.40**					
Perp. Neglect PR	.12	.00	.04	.32**	.10	.30**	.17	.05				
Perp. Neglect CR	.04	-.09	-.03	.18*	.29**	-.01	-.17	.02	.36**			
Gender G2	-.05	-.05	.07	-.03	.00	.05	.01	-.05	-.21**	-.17*		
Age G2	.20**	.10	.01	.10	.12	.34**	-.14	.00	.25**	-.05	-.14*	
Household SES	-.04	-.06	-.14	-.10	.00	-.09	.01	.11	.18*	-.14	-.04	.08

Note: CR = Child report; FR = Father report; MR = mother report; PR = Parent report; Exp. = maltreatment experienced by G2; Perp. = maltreatment perpetrated by G2; Gender: male coded as 1 and female coded as 2. Exp. Abuse FR indicate the abuse that was experienced by the child, but was perpetrated and reported by the father. The same applies to Exp. Abuse MR. * $p < .05$; ** $p < .01$

$p = .005$) and neglect ($r(190) = .34, p < .001$) increased with age (CR). Higher household SES was associated with more PR perpetrated neglect ($r(190) = .18, p = .013$).

Intergenerational transmission of abuse and neglect

We tested whether participants from G2 ($n = 191$; including five G3 participants who also reported on perpetrated maltreatment) were more likely to perpetrate maltreatment if they had been maltreated during their childhood in stepwise multilevel models for abuse and neglect separately.

Intergenerational transmission from the perspective of one reporter

Results of the stepwise multilevel model for abuse and neglect from the perspective of one reporter are presented in Table 2.3. For abuse, the unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.06 at the family level, indicating that 6% of the variance in self-reported perpetrated abuse can be explained by differences between families. Age, gender and SES were included in the next step (Model 2).

Table 2.3. Stepwise multilevel model for abuse and neglect testing intergenerational transmission from the perspective of one reporter

	Model 1	Model 2	Model 3
Dependent variable: Perpetrated abuse			
Fixed effects	Coef (se)	Coef (se)	Coef (se)
Intercept	1.57 (0.07)***	1.19 (0.41)**	0.84 (0.36)**
Gender		-0.04 (0.13)	-0.02 (0.12)
Age		0.01 (0.01)	0.01 (0.01)
SES		-0.13 (0.09)	-0.10 (0.08)
Experienced Abuse			0.36 (0.05)***
Variance components			
Individual level	0.79	0.78	0.62
Family level	0.05	0.04	0.01
Dependent variable: Perpetrated neglect			
Fixed effects	Coef (se)	Coef (se)	Coef (se)
Intercept	1.61 (0.07)**	1.13 (0.42)**	1.10 (0.40)**
Gender		-0.35 (0.14)*	-0.40 (0.01)**
Age		0.02 (0.01)**	0.01 (0.01)
SES		0.22 (0.10)*	0.27 (0.10)**
Experienced Neglect			0.21 (0.05)***
Variance components			
Individual level	1.00	0.89	0.82
Family level	0.00	0.00	0.00

Note. The unstandardized coefficients are represented. * $p < .05$, ** $p < .01$, *** $p < .001$

None of the covariates were significantly related to self-reported perpetrated abuse and the fit of model was not significantly better than the fit of model 1 ($\chi^2(3) = 3.86, p = .277$). In the next step (Model 3), self-reported experienced abuse was included, which significantly improved model fit compared to Model 2 ($\chi^2(1) = 50.90, p < .001$). Self-reported experienced abuse was significantly positively associated with self-reported perpetrated abuse ($\beta = 0.47, p < .001$), indicating intergenerational transmission of abuse when viewed from the perspective of one reporter. Results remained the same when including self-reported experienced neglect as a predictor in the last step (β of self-reported perpetrated abuse remained 0.47), meaning that self-reported experienced abuse was uniquely associated with self-reported perpetrated abuse.

For neglect the same steps were followed. The unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.00 at the family level, indicating that variance in self-reported perpetrated neglect is not explained by differences between families. Covariates were included in the next step (Model 2), which significantly improved the fit of the model ($\chi^2(3) = 23.69, p < .001$). Gender ($\beta = -0.17, p = .013$), age ($\beta = 0.37, p = .002$) and household SES ($\beta = 0.15, p = .023$) were significantly associated with self-reported perpetrated neglect, indicating that males, older participants and participants from households with a higher SES reported more perpetrated neglect towards their child(ren). Including self-reported experienced neglect in a third step (Model 3) increased the model fit significantly ($\chi^2(1) = 15.94, p < .001$). Self-reported experienced neglect was significantly positively associated with self-reported perpetrated neglect ($\beta = 0.28, p < .001$), indicating intergenerational transmission of neglect from the perspective of one reporter. Self-reported experienced neglect remained significantly associated with self-reported perpetrated neglect ($\beta = 0.31, p < .001$) after including self-reported abuse in a third step, meaning that self-reported experienced neglect was uniquely associated with self-reported perpetrated neglect.

Intergenerational transmission from the perspective of different reporters from each generation

Results of the stepwise multilevel model for abuse and neglect from the perspective of different reporters from each generation are presented in Table 2.4. For abuse, the unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.30 at the family level, indicating that 30% of the variance in G2 perpetrated abuse *reported by* G3 can be explained by differences between families. Age, gender and SES were included in the next step (Model 2). None of the covariates were significantly related to self-reported perpetrated abuse and model fit did not improve ($\chi^2(3) = 4.41, p = .220$). In a next step, experienced abuse reported by G2 was included, which improved the model fit significantly ($\chi^2(1) = 8.25, p = .004$). Experienced abuse reported by G2 was significantly positively associated with G2 perpetrated abuse ($\beta = 0.20, p = .005$), indicating

that there was intergenerational transmission of abuse when viewed from the perspective of different reporters from each generation. The association between experienced abuse reported by G2 and G2 perpetrated abuse remained significant ($\beta = 0.18$, $p = .018$) after controlling for experienced neglect reported by G2, indicating that experienced abuse reported by G2 was uniquely associated with G2 perpetrated abuse.

For neglect, the unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.31 at the family level, indicating that 31% of the variance in G2 perpetrated neglect *reported by G3* can be explained by differences between families. Inclusion of covariates in the next step (Model 2) significantly increased the model fit ($\chi^2(3) = 11.15$, $p = .011$). Of the covariates, only gender of G2 was significantly associated with G2 perpetrated neglect ($\beta = -0.20$, $p = .006$), indicating that children reported to be neglected by fathers more often. Experienced neglect reported by G2 was included in a next step (Model 3), which did not significantly increase the model fit ($\chi^2(1) = 0.15$, $p = .699$).

Table 2.4. Stepwise multilevel model for abuse and neglect testing intergenerational transmission from the perspective of different reporters from each generation

	Model 1	Model 2	Model 3
Dependent variable: Perpetrated abuse			
Fixed effects	Coef (se)	Coef (se)	Coef (se)
Intercept	1.44 (0.10)***	0.64 (0.55)	0.47 (0.55)
Gender		0.09 (0.14)	0.10 (0.14)
Age		0.01 (0.01)	0.01 (0.01)
SES		-0.01 (0.12)	0.01 (0.12)
Experienced Abuse			0.16 (0.06)**
Variance components			
Individual level	0.74	0.71	0.71
Family level	0.31	0.33	0.24
Dependent variable: Perpetrated neglect			
Fixed effects	Coef (se)	Coef (se)	Coef (se)
Intercept	2.18 (0.11)***	3.23 (0.57)***	3.23 (0.57)***
Gender		-0.40 (0.15)**	-0.40 (0.15)**
Age		-0.01 (0.01)	-0.01 (0.01)
SES		-0.13 (0.13)	-0.13 (0.13)
Experienced Neglect			-0.01 (0.06)
Variance components			
Individual level	0.83	0.78	0.78
Family level	0.38	0.36	0.36

Note. The unstandardized coefficients are represented. * $p < .05$, ** $p < .01$, *** $p < .001$

Moreover, experienced neglect reported by G2 was not significantly associated with G2 perpetrated neglect ($\beta = -0.01, p = .989$). The association remained non-significant ($\beta = -0.02, p = .768$) when controlled for experienced abuse reported by G2, indicating no unique effects of experienced neglect reported by G2 on G2 perpetrated neglect.

Intergenerational transmission using a multi-informant approach

Results of the stepwise multilevel model for abuse and neglect using a multi-informant approach are presented in Table 2.5. For abuse, the unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.19 at the family level, indicating that 19% of the variance in the multi-informant scores of perpetrated abuse by G2 (parent and child report averaged) can be explained by differences between families. Age, gender and household SES were included in the first step, which did not significantly increase the fit of the model ($\chi^2(3) = 4.73, p = .193$). None of the covariates were significantly related to perpetrated abuse. In the third step (Model 3), the component *Reporter convergence* was included, which significantly improved the fit of the model ($\chi^2(1) = 17.26, p < .001$). *Reporter convergence* was positively and significantly associated with perpetrated abuse ($\beta = 0.29, p = .001$), supporting intergenerational transmission based on agreement between all reporters. In the fourth step (Model 4) the components *Mother report* and *Father versus child report* were added, which significantly improved model fit ($\chi^2(2) = 27.83, p < .001$). *Father versus child report* was significantly and negatively associated with perpetrated abuse ($\beta = -0.33, p = .002$) indicating that the discrepancy in father and child reports on experienced abuse improved the prediction of perpetrated abuse beyond the component *Reporter convergence*. *Mother report* was not significantly associated with perpetrated abuse ($\beta = -0.04, p = .703$). Associations of the components *Convergence* and *Father versus child report* of abuse with perpetrated abuse remained significant ($\beta = 0.35, p < .001$ and $\beta = -0.32, p = .003$, respectively) when including the component *Reporter convergence* of Neglect in a fourth step. This indicates that the components *Convergence* and *Father versus child report* of experienced abuse were uniquely associated with perpetrated abuse, when controlling for neglect.

For neglect the same steps were followed. The unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.12 at the family level, indicating that 12% of the variance in the multi-informant scores of perpetrated abuse by G2 (parent and child report averaged) can be explained by differences between families. Covariates were included in the next step (Model 2), which significantly increased the fit of the model ($\chi^2(3) = 12.41, p = .006$). Of the covariates, only gender was significantly related to perpetrated neglect ($\beta = -0.21, p = .003$), indicating that on average men perpetrated more neglect than women. The component *Reporter convergence* was included in the next step. Model fit did not improve ($\chi^2(1) = 2.14, p = .144$) and *Reporter convergence* was not significantly associated with perpetrated neglect ($\beta = 0.07, p = .508$), suggesting that intergenerational transmission of neglect as observed by all informants was not

supported. The components *Child report* and *Mother versus father report* were added in the fourth step (Model 4), which significantly improved the fit of the model ($\chi^2(2) = 7.62$, $p = .022$). However, both *Child report* ($\beta = 0.15$, $p = .109$) and *Mother versus father report* ($\beta = 0.07$, $p = .509$) were not significantly associated with perpetrated neglect, indicating that the divergent reports on experienced neglect did not contribute to the prediction of perpetrated neglect beyond the component *Reporter convergence*. When including the component *Convergence of abuse* in a last step, all associations of the components of neglect with perpetrated neglect remained non-significant (*Reporter convergence*: $\beta = 0.07$, $p = .463$, *Child report*: $\beta = 0.15$, $p = .102$, *Mother versus father report*: ($\beta = 0.08$, $p = .565$). This indicates that convergence of informants and unique perspectives of informants on experienced neglect were not uniquely associated with perpetrated neglect.

Table 2.5. Stepwise multilevel model for abuse and neglect using a multi-informant approach

	Model 1	Model 2	Model 3	Model 4
Dependent variable: Perpetrated abuse				
Fixed effects	Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept	1.51 (0.07)***	0.92 (0.38)*	1.01 (0.37)**	1.12 (0.35)**
Gender		0.03 (0.11)	0.03 (0.11)	0.03 (0.10)
Age		0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
SES		-0.06 (0.08)	-0.02 (0.08)	-0.04 (0.07)
Reporter convergence			0.14 (0.04)**	0.14 (0.04)***
Mother report				-0.05 (0.13)
Father vs. Child				-0.40 (0.13)**
Variance components				
Individual level	0.51	0.49	0.46	0.42
Family level	0.12	0.12	0.09	0.05
Dependent variable: Perpetrated neglect				
Fixed effects	Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept	1.90 (0.07)	2.14 (0.41)***	2.14 (0.41)***	2.43 (0.44)*
Gender		-0.36 (0.12)**	-0.36 (0.12)**	-0.39 (0.12)**
Age		0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
SES		0.03 (0.09)	0.03 (0.09)	0.05 (0.10)
Reporter convergence			0.04 (0.06)	0.04 (0.06)
Child report				0.14 (0.09)
Mother vs. Father				0.11 (0.20)
Variance components				
Individual level	0.66	0.61	0.60	0.58
Family level	0.09	0.09	0.09	0.09

Note. The unstandardized coefficients are represented. * $p < .05$, ** $p < .01$, *** $p < .001$

Discussion

The three-generational multi-informant design of the 3G Parenting Study enabled us to investigate intergenerational transmission of child maltreatment (ITCM) using multiple sources of information on abuse and neglect, i.e., mothers, fathers and children. Our study offers new insight into reporter effects on ITCM: a) intergenerational transmission of abuse was consistently found across approaches – from the perspective of one reporter, from the perspective of different reporters from each generation and using the multisource approach, b) father versus child report contributed significantly to the prediction of perpetrated abuse, and c) intergenerational transmission of neglect was only found using the perspective and data of one single reporter.

Agreement and integration of different reports

In line with previous results on part of the sample (Compier- de Block et al., 2016) agreement between mothers, fathers and children on abuse and neglect was modest. The lowest agreement was found between children and parents on neglect, whereas the highest agreement was between fathers and mothers on neglect. Compier- de Block and colleagues (2016) suggested that there might be a gap between what parents feel (i.e., love) and what they convey (i.e., tell your children you love them), explaining the low agreement between parents and children. In addition, discrepancies between parents and children on neglect may occur due to changing beliefs across generations about appropriate parenting practices. Finally, abuse describes the presence of behavior whereas neglect describes the absence of behavior. It is possible to estimate the presence of behaviors without judging whether that behavior was adequate (e.g., My mother/ father shouted, yelled or screamed at me), whereas estimating the absence of behavior usually requires a judgment whether the behavior should have been present (e.g., My father/mother was not able to make sure that I got to the doctor or hospital when needed). The measurement of neglect might therefore be more subjective than the measurement of abuse. Parent couples, however, reported fairly similar neglectful behavior. This might be explained by the fact that many parents share attitudes and beliefs about appropriate parenting practices that guide their behavior (Bornstein, Putnick, & Lansford, 2011).

Results of the PCA were in line with Kraemer's prediction that all informants should contribute to the first component in the same direction (i.e., positive component loadings) if they are well selected. A useful component structure with three components was established in which the first component reflected the convergent reports of informants and the other components reflected unique perspectives on the occurrence of maltreatment. Since parents reported only on their own behavior, it is difficult to determine whether convergence reflects similarity in behavior or similarity in perception of behavior. In line with a previous study that applied this approach to maltreatment (Sierau et al., 2017),

convergent reports explained most of the variance (around 50%) in abuse and neglect, despite challenges in querying children and caregivers on this subject, distorted memories (Edwards et al., 2001) or reluctance to report on maltreatment (Della Femina et al., 1990; Knight et al., 2000). More importantly, including multiple perspectives may increase validity, since random error and systematic bias is reduced. It should be noted that child report contributed less to convergence for neglect than for abuse, which confirms the results of the intra-class correlations that revealed low agreement between children and parents on the occurrence of neglect.

For convergence on abuse, we found very similar weights for child, father, and mother report (i.e., 0.76, 0.75, and 0.72 respectively). This means that the convergence score calculated in the current study is virtually equivalent to a mean score of the three reporters. Thus, for researchers primarily interested in a combined multi-informant score of abuse a mean score may suffice. However, replication of this finding is warranted. Combining neglect scores from parents and children may be more complex as there might be more disagreement between them. Ultimately, the specific research question should guide decisions on the method of combining maltreatment reports. In the current study we chose a data-driven approach of combining reports (i.e., PCA) but for research questions that underlie a hypothetical process or construct, a theory-driven approach might be better suited.

2

Intergenerational transmission of child maltreatment

With regard to the predictive strength of the components in ITCM, the convergent perspective of experienced abuse predicted perpetrated abuse, indicating intergenerational transmission of abuse when multiple perspectives are combined. Intergenerational transmission of abuse was also found using more conventional approaches: i.e., reports of only one informant or reports of different reporters from each generation (see Figure 2.1 for an illustration). This suggests that in the present study evidence of intergenerational transmission of abuse was found independent of the source of information. Nevertheless, the approach of testing ITCM can affect the magnitude of the transmission. If only one perspective was included the standardized regression coefficient was the highest ($\beta = 0.47$) compared to including multiple informants ($\beta < 29\%$). Thus, reporter effects, such as distorted memories or reluctance to report on incidences of maltreatment, may play a role but cannot fully explain the intergenerational transmission of abuse.

The component father versus child report on experienced abuse explained additional variance in the perpetration of abuse above and beyond the convergent reports of all informants. This indicates that differences in reports of G1 fathers (i.e., grandfathers) and G2 children on abuse experienced by G2 were predictive of G2 perpetrated abuse towards G3. The transmission was strongest when children reported higher levels of abuse than fathers. Possibly, this indicates that sharing a similar perspective might buffer the

negative effects of maltreatment to some extent. Our findings thus provide support for the relevance of including fathers in research on ITCM, despite the fact that most studies on ITCM focused only on mothers (Berlin et al., 2011; Egeland et al., 1988; Thornberry et al., 2012). Even though sex differences exist in child maltreatment prevalence rates, research clearly indicates that both boys and girls may be victims of child maltreatment and that fathers just as mothers may be perpetrators (Euser et al., 2013; Sedlak et al., 2010). Thus, considering child maltreatment prevalence rates, there seems little reason to exclude fathers in ITCM research. Results of the current study showed that fathers compared to mother were more likely to neglect their children across approaches that were used to estimate ITCM, emphasizing the relevance of studying predictors of neglect perpetrated by fathers. Finally, including fathers in research on maltreatment may be especially important since fathers' involvement in child care has continuously increased in many Western countries the past few decades, while empirical studies are still relatively scarce (Kan, Sullivan, & Gershuny, 2011; Jones & Mosher, 2013).

Regarding neglect, we found evidence for intergenerational transmission of neglect when using the perspective of one reporter, i.e., self-reported experienced neglect predicted self-reported perpetrated neglect. This confirms our first hypothesis: ITCM was found for both abuse and neglect when one informant reports about experienced and perpetrated maltreatment. Yet, transmission of neglect was not confirmed with our component-analytical approach or when reports of different informants from each generation were used, i.e., experienced neglect reported by G2 was not significantly associated with G2 perpetrated neglect reported by G3. Intergenerational transmission of neglect thus seemed to disappear when reports of multiple informants are used. Possibly, neglect is not transmitted from one generation to the next because neglect is not associated with observable parental behavior which can be modelled by children when they become parents themselves. It has repeatedly been discussed that bias is likely in studies on ITCM when a single reporter for the independent and dependent variables is used (Pears & Capaldi, 2001; Thornberry et al., 2012). For example, parents may overreport victimization as a means to defend their own perpetrating behavior (Tajima et al., 2004). Conversely they may underreport their victimization to protect those who maltreated them or a desire to forget the victimization (Della Femina et al., 1990). Hence, it can be called into question whether neglectful behavior is truly transmitted from one generation to the next, or whether evidence of transmission is driven by dependency of the perceptions of one person. This may be particularly relevant considering the modest agreement between parents and children discussed earlier.

Finally, the amount of variance in maltreatment explained by the family-level differed across approaches. For the approach that tested ITCM using different reporters of experienced maltreatment for the perspective of each generation a relatively large amount of variance ($\pm 30\%$) in abuse and neglect was explained by differences between

families. This was probably driven by child reporters that rated the maltreating behavior of their fathers and mothers in a similar way.

Dealing with missing data

Our three-generational design enabled us to include reports from parents and children of both experienced and perpetrated maltreatment in estimating ITCM, thereby reducing reporter bias. However, recruiting families is challenging and missingness due to family members who do not participate is quite high. Yet, we would argue that the risk of missingness should not discourage researchers from using multi-informant methods to estimate and investigate ITCM, since modern techniques for handling missing data such as Multiple Imputation (MI) offer compelling solutions. Many statisticians consider MI the “gold standard” for handling missing data, because it produces less bias than other typical methods (Allison, 2002; Graham, 2009). MI has been shown to be statistically sound especially for large percentages of missing values as wider confidence intervals will be generated for variables with more missing data, avoiding the risk of false positives (Graham, 2009).

While the use of MI appears to be on the rise (Sterne et al., 2009) it is far from being standard practice. Several reviews of the handling of missing data in various fields showed that only very few studies used MI (i.e., Sullivan, Yelland, Lee, Ryan, & Salter, 2017; Rombach, Rivero-Arias, Alastair, Gray, Jenkinson, & Burke, 2016). This might be problematic in the context of child maltreatment as our results show that parents who did not participate may differ systematically from those who participated in terms of abuse and neglect. Specifically – according to their children – parents who did not participate were more likely to neglect but less likely to abuse their children. It is not difficult to imagine that neglectful parents are also less likely to participate with their children in research. The finding that parents with higher scores on abuse did not refrain from participation in the study is promising and adds to the reliability of our findings. We were able to use this and other information in our prediction model for MI. As such, MI offers a useful solution for systematic missingness. Imputations converged across datasets and correlations between variables were approximately similar for non-imputed and multiply imputed data. Findings of the present study thus suggest that having complete families is not required when estimating ITCM based on integrated data from multiple informants.

Limitations

The current study is not without limitations. First, the majority of the participants were adults and reported about childhood events retrospectively. The retrospective nature of these reports may increase measurement error and false negatives due to memory loss (Hardt & Rutter, 2004). Most ITCM studies with prospective designs have a short follow-up period (Thornberry et al., 2012). As a result they generally only cover the first

period of childhood – potentially missing maltreatment with a later onset. A prospective study following three generations may not be feasible and a retrospective design with multiple reporters might be the second best option. The design of the current study allowed us to cover parenting experiences across the entire span of growing up for most participants. Lastly, bias due to retrospective reporting should not be given too much weight as research has shown that false positives in maltreatment research are rare and associations with psychopathology are comparable for retrospective and prospective reports (Hardt & Rutter, 2004; Scott, McLaughlin, Smith, & Ellis, 2012). Another limitation of the current study was that the sample is not fully representative of the general population, because the majority of the participants in our sample had a Caucasian background. In addition, it is important to recognize that parents only report on their own behavior allowing for different interpretations of convergence of mother and father report. While combining multiple reports on child maltreatment adds valuable information, an even more comprehensive picture could be gained by asking parents also about their partners' behavior. This would also support disentangling perceptions from behavior.

Implications

With regard to policy and clinical practice, our data suggest that including multiple informants in research on ITCM may be valuable for obtaining a comprehensive picture of maltreatment incidences and their consequences for parenting behavior in the next generation. Moreover, combining multiple perspectives in prevalence studies may reduce random error and systematic bias in prevalence estimates. Conversely, whenever informants differ, professionals should carefully attend to the exact pattern of reports. Father reports may turn out to be especially informative regarding risk for ITCM, but the precise implications should be explored further. Including both mothers and fathers should become standard practice in child maltreatment research.

Conclusion

In conclusion, this is one of very few ITCM studies that uses multi-informant reports and includes fathers. We found evidence of intergenerational transmission of abuse using three different methods (see Figure 2.1). In addition to convergent reports of mother, father and child on experienced abuse, father vs. child report on experienced abuse uniquely contributed to the prediction of perpetrated abuse, highlighting the importance of including fathers in research on ITCM. For neglect, intergenerational transmission was only found when the same individual reported on experienced and perpetrated neglect calling into question whether there is “actual” transmission of neglect. Neglect represents the absence of behavior and is a more abstract construct which might be difficult to assess. Although research has shifted more towards studying neglect, continued efforts are needed to improve our understanding of the assessment, precursors and sequelae of neglect.

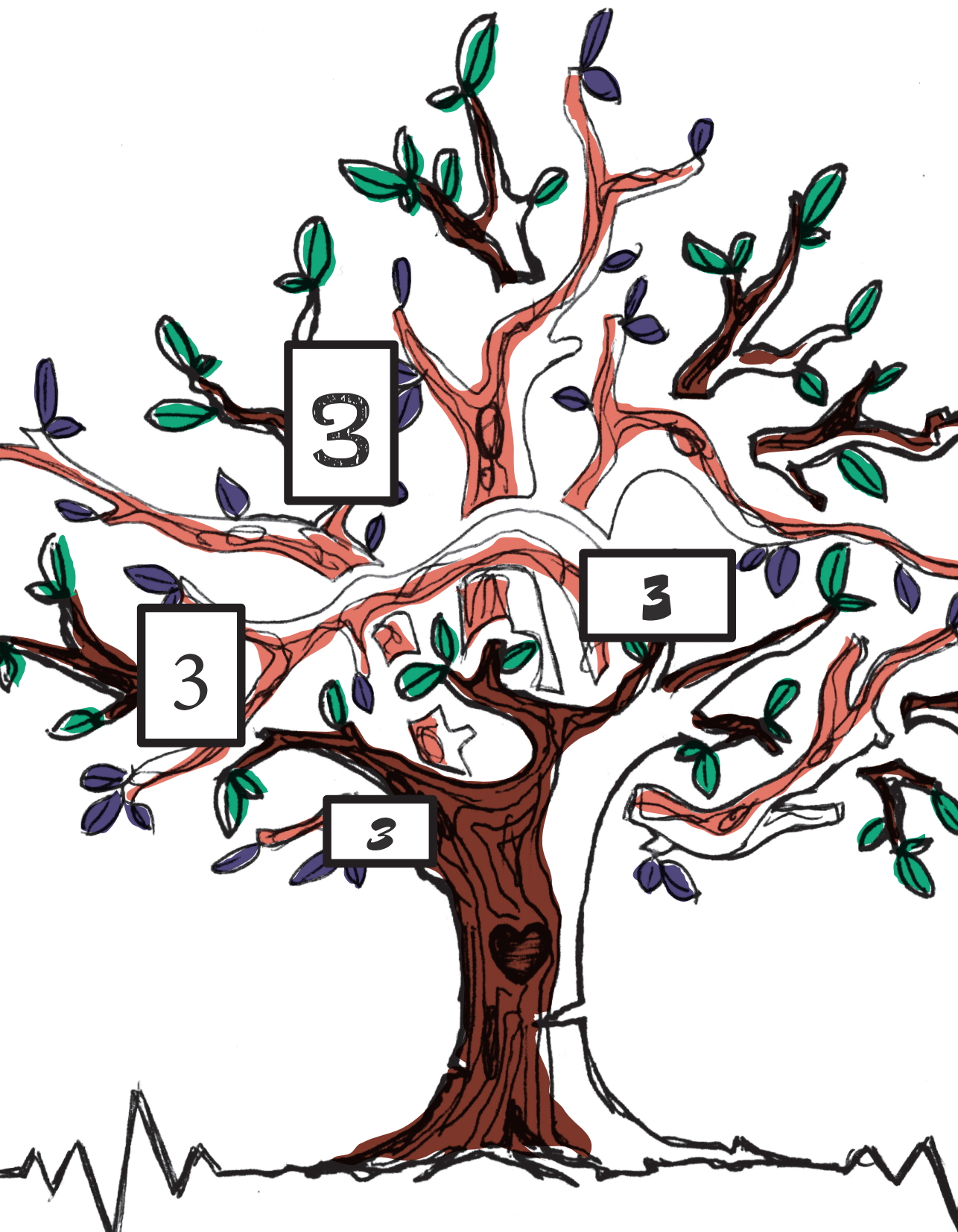
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3

Chapter 3

The past is present: the role of maltreatment history in perceptual, behavioral and autonomic responses to infant emotional signals

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Abstract

In the current study associations between parents' experiences of childhood maltreatment and their perceptual, behavioral and autonomic responses to infant emotional signals were examined in a sample of 160 parents. Experienced maltreatment (both physical and emotional abuse and neglect) was reported by the participants and, in approximately half of the cases, also by their parents. During a standardized infant vocalization paradigm, participants were asked to squeeze a handgrip dynamometer at maximal and at half strength while listening to infant crying and laughter sounds and to rate their perception of the sounds. In addition, their heart rate (HR), pre-ejection period (PEP), and vagal tone (RSA) were measured as indicators of underlying sympathetic and parasympathetic reactivity. Results indicated that participants did not differ in their perceptions of the infant vocalizations signals according to their maltreatment experiences. However, maltreatment experiences were associated with the modulation of behavioral responses. Experiences of neglect during childhood were related to more handgrip force during infant crying and to less handgrip force during infant laughter. Moreover, a history of neglect was associated with a higher HR and a shorter PEP during the entire infant vocalization paradigm, which may indicate chronic cardiovascular arousal. The findings imply that a history of childhood neglect negatively influences parents' capacities to regulate their emotions and behavior, which would be problematic when reacting to children's emotional expressions.

Keywords: child maltreatment history, infant crying, handgrip force, autonomic reactivity, emotion regulation

Introduction

The experience of childhood maltreatment has long-term negative consequences for a range of behaviors, including those associated with later parenting (Norman et al., 2012; Pears & Capaldi, 2001). Emotional dysregulation can be considered a key pathway through which experiences of child maltreatment influence how parents respond to their children. Numerous studies have shown that adverse caregiving experiences, including child maltreatment, contribute to emotion dysregulation in general (e.g., Dvir, Ford, Hill, & Frazier, 2014), yet fewer attempts have been made to study the effects of childhood maltreatment on emotion regulation specifically in response to child emotional signals. Only three studies so far have examined whether parents' history of maltreatment was related to their emotion regulation and responding to infant emotional signals, using relatively small samples of mothers only (Casanova, Domanic, McCanne, & Milner, 1994; Compier-de Block et al., 2015; Reijman et al., 2014). Since emotion regulation and responding to infant emotional signals are considered important mechanisms underlying sensitive parenting (e.g., Joosen et al., 2013; Reijman et al., 2016), a significant gap in the literature exists. In the current study, we examined whether parents' childhood maltreatment experiences contribute to their emotion regulation and response to infant distress in a large sample of both mothers and fathers. Previous studies have used either cognitive, physiological, or behavioral measures as indices of emotion regulation in response to infant emotional signals (e.g., Compier-de Block et al., 2015; Groh & Roisman, 2009). To our knowledge this study is the first to examine all three domains, in both fathers and mothers.

Attachment theory (Bowlby, 1969) offers an integrative theoretical framework to understand how exposure to childhood maltreatment can impact adult processing of and responding to child emotional signals. A central tenet of attachment theory (Bowlby, 1969) is that children develop an internal working model (i.e., a mental representation) of the self and others through repeated interactions with their primary caregiver(s), which guides their future social and emotional behavior. These internal working models are assumed to characterize distinct strategies of emotion regulation that children and adults employ to manage distress and negative emotions in a range of contexts, including interactions of parents with their children (Mikulincer & Shaver, 2008). Experiences of childhood maltreatment have been longitudinally linked to adults' formation of insecure working models (Raby, Labella, Martin, Carlson, & Roisman, 2017), and insecure working models in turn have been found to translate into insensitive caregiving behavior (Dykas & Cassidy, 2011). Moreover, it has been suggested that individual variation in adults' internal working models as reflected in different styles of emotional responding is most evident when adults are confronted with attachment-related stressors (Kobak, Cole, Ferenz-Gillies, Fleming, & Gamble, 1993). Infant crying is a typical attachment-related stressor and has been shown to elicit physiological arousal in both parents and non-parents, and in both females and males (Frodi, Lamb, Leavitt, & Donovan,

1978; Groh & Roisman, 2009). Crying may be adaptive and necessary for a baby's survival (Bowlby, 1969), but it can also evoke irritation and may trigger abuse and neglect (e.g., Out, Bakermans-Kranenburg, van Pelt, & van IJzendoorn, 2012).

An important prerequisite for emotion regulation and responding to emotional stimuli is the ability to process social information effectively (Gross, 2002). According to Dykas and Cassidy (2011), individuals process social information in accordance with their attachment-related experiences. Secure individuals draw on their positive attachment-related knowledge to process social information in a positively biased manner, whereas insecure individuals process attachment-relevant social information in a negatively biased manner. Thus, parents' experiences of childhood maltreatment might influence the way in which they process child emotional signals. Indeed, it was shown that mothers who received harsh parenting during childhood had more negative attitudes about their child's behavior (Daggett, O'Brien, Zanolli, & Peyton, 2000). Furthermore, adults with a history of parental emotional rejection have been found to make more negative attributions (e.g., child just wants attention, is selfish) about a distressed infant (Leerkes & Siepak, 2006).

The experience of childhood maltreatment may also compromise parents' autonomic responses to child emotional signals. The autonomic nervous system (ANS) is part of the peripheral nervous system that influences the function of internal organs, and has two main divisions: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). Generally, the SNS causes bodily energy mobilization during stressful or emergency situations, whereas the PNS is concerned with energy conservation and restoration during resting states (Larsen, Schneiderman, & DeCarlo Pasin, 1986). Measurement of heart rate (HR) alone does not indicate whether SNS or PNS influences are predominant. A widely used measure to monitor changes in cardiac SNS activity is the pre-ejection period (PEP), which is determined by indirect measurement of systolic time intervals and reflects cardiac contractility (Newlin & Levenson, 1979). The degree of cardiac control by the PNS division is commonly quantified by measuring the amplitude of respiratory sinus arrhythmia (RSA; Porges, 1995). In a typical stress response, HR will increase, PEP will decrease due to a shortening of the systolic period, and RSA will decrease due to inhibition of the vagal brake.

Studies that focused on the association between ANS reactivity to psychosocial stressors and childhood maltreatment mainly point to physiological *hyper*-reactivity in response to stressors (i.e., overarousal) after childhood maltreatment (e.g., Heim et al., 2000; Dale et al., 2009), but *hypo*-reactivity (i.e., underarousal) has also been documented (e.g., Ginty, Masters, Nelson, Kaye, & Conklin, 2016). To our knowledge only two studies have associated maltreatment experiences with ANS reactivity specifically to child emotional signals (Casanova et al., 1994; Reijman et al., 2014). In both studies differential reactivity to infant emotional signals was found depending on maltreatment experiences, however, conclusions warrant caution because sample sizes were small.

In addition to ANS reactivity, which reflects responsivity to distress, a history of childhood maltreatment may compromise sustained (i.e., basal) ANS activation. Sustained ANS activation may more generally represent the capacity for emotion regulation (Appelhans & Luecken, 2006). In spite of a paucity of research, convergent findings point to chronic ANS arousal as a result of childhood maltreatment experiences (e.g., Dale et al., 2009; Miskovic, Schmidt, Georgiades, Boyle, & MacMillan, 2009).

The influence of childhood maltreatment experiences on emotion regulation and responding may not only be reflected in physiological dysregulation, but also in behavioral dysregulation. A documented way to operationalize behavioral responses to infant signals is to use a handgrip dynamometer to measure participants' use of excessive force when exposed to infant stimuli. According to Bugental et al. (1999) adults who process the motives of their children in a negatively biased manner might use excessive punitive force in order to control their children. This reasoning finds support in the study of Riem et al. (2012) who used the handgrip dynamometer to examine the association between attachment representations and behavioral reactivity to infant crying. Adults with insecure attachment representations experienced more irritation and used more excessive force when listening to infant crying than individuals with secure representations. Lack of modulation of handgrip force might thus be a correlate of insecure internal working models. Moreover, research has shown that maltreating mothers used excessive force more often while listening to infant crying and laughter than non-maltreating mothers (Compier-de Block et al., 2015). The inability to modulate behavioral responses to infant emotional signals might, therefore, be a risk factor for maltreating behavior. Although the association between excessive handgrip force and maltreatment history was not significant in this study, the group of mothers who experienced childhood maltreatment was small ($n = 39$), which might have limited the power to detect an effect.

Lastly, it may be important to distinguish between experiences of abuse *versus* neglect when examining the consequences of child maltreatment on the regulation of stress and emotion, though few studies did so. Child neglect implies an act of *omission* and is related to the failure to meet the child's physical and emotional needs, whereas child abuse implies acts of *commission* which can be verbal or physical. Both abuse and neglect have been associated with maladaptive development, yet it is still unclear whether abuse and neglect differentially affect behavioral and biological systems (Gunnar & Quevedo, 2007).

In the current study cognitive, physiological, and behavioral responses to infant emotional vocalizations were examined in relation to experienced childhood maltreatment. We hypothesized that individuals with childhood maltreatment experiences (physical and emotional neglect vs. physical and emotional abuse) are more likely to report negative feelings and exhibit autonomic *hyper*-reactivity (HR increase, PEP and RSA decrease) in response to infant crying. It was also hypothesized that childhood maltreatment experiences are associated with overall sustained physiological arousal. On the behavioral

level, childhood maltreatment experiences are expected to predict lower modulation of handgrip force (and thus more excessive force) in response to infant crying. To explore whether the effects of experienced maltreatment on cognitive, behavioral and autonomic responses were specific to infant crying, infant cry sounds were compared to infant laughter sounds.

Method

Participants

Participants of the current study were part of the larger 3G Parenting Study, a family study on the intergenerational transmission of parenting styles, stress and emotion regulation (see also Compier-de Block et al., 2016). Participants from the current study were recruited via three other studies that included the assessment of caregiving experiences (Joosen, Mesman, Bakermans-Kranenburg, & van IJzendoorn, 2013; Penninx et al., 2008; Scherpenzeel, 2011). From two of these studies we recruited only participants who reported that they had experienced some form of maltreatment in their childhood. All participants from the third study were recruited. Thus, participants with an increased risk of experienced maltreatment were oversampled. From these studies, individuals who had agreed to being invited for participation in future studies, and who had at least one child of 8 years or older were invited. These individuals served as target participants. A total of 63 target participants agreed to participate in the current study. After their consent, we invited their family members (parents, partners, children, adult siblings, nephews, nieces and in-laws) to participate as well. This resulted in a total of 332 family members who also agreed to participate. The included family members were not screened for childhood maltreatment.

The infant vocalizations paradigm was administered to parents who were not older than 70 years to prevent confounds due to hearing loss and other medical conditions (e.g., hypertension). A total of 190 participants were eligible for the task. However, due to technical problems, schedule mistakes, and lack of time during the lab visits 30 participants did not complete the infant vocalizations paradigm and were excluded. Due to technical problems, 13 participants had missing data on handgrip force, and an additional 12 participants (nine for technical reasons, three because of a heart condition incompatible with electrocardiogram analysis) had no physiological data. Therefore 160 participants were included in the perception analysis, 147 participants in the analysis on behavioral responses, and 135 participants in the analyses on autonomic responses. See Supplementary material Chapter 3 for a comparison of included and excluded participants on demographics and childhood maltreatment experiences.

Procedure

Participants and their families were invited to the lab for one or two days, depending on family composition. Participants with children visited the lab once with their nuclear family and once with their family of origin (if their parents were willing and able to participate). During the lab visits, participants individually completed computer tasks and questionnaires, and did several interaction tasks together with other family members. Furthermore, saliva and hair samples were collected, and during specific tasks skin conductance and heart rate were measured. Eligible participants were also invited for a functional magnetic resonance imaging (fMRI) session. The study was approved by the ethics committee of the Leiden University Medical Center. Written informed consent was obtained from all participants before participation. As a compensation for participation, adults received 50 Euros for one lab visit and up to 100 Euros for two lab visits, as well as travelling expenses.

Measures

Childhood maltreatment

Experienced abuse and neglect were assessed with the Conflict Tactics Scale, Parent-Child version (CTS-PC, Straus, Hamby, Finkelhor, Moore, & Runyan, 1998) supplemented with items from the Childhood Trauma Questionnaire (CTQ, Bernstein et al., 1994; see also Compier-de Block et al., 2016). The CTS-PC and the CTQ have demonstrated construct validity in measuring a range of child maltreatment behaviors (Bernstein et al., 1994; Straus et al., 1998). Participants filled out a version in which they reported on experienced childhood maltreatment before the age of 18 years by (each of) their parent(s). Their parents filled out a version that assessed the extent to which they had conducted maltreating behaviors towards (each of) their child(ren) in the past, before their children had reached the age of 18 years.

The CTS-PC originally consists of four scales. In the current study, the *Nonviolent Discipline* scale (4 items) was excluded, because it includes no items on maltreatment. The *Psychological aggression* scale (i.e., emotional abuse) consists of 5 items (e.g., “Shouted, yelled, or screamed at me”). Cronbach's alphas were adequate: $\alpha_{\text{mother}} = .81$, $\alpha_{\text{father}} = .73$. *Physical Assault* (i.e., physical abuse) is comprised of 13 items, including corporal punishment (5 items, e.g., “Being spanked on the bottom with a bare hand”), severe assault (4 items, e.g., “Being hit with a fist or kicked hard”), and very severe assault (4 items, e.g., “Being burned or scalded”). Cronbach's alphas for Physical Assault were excellent: $\alpha_{\text{mother}} = .92$, $\alpha_{\text{father}} = .93$. The *Neglect* scale consists of 5 items (e.g., “My father/mother was not able to make sure I got the food I needed”). Cronbach's alphas for the four items about physical neglect were adequate: $\alpha_{\text{mother}} = .73$, $\alpha_{\text{father}} = .67$. Since the *Neglect* scale includes only one item on emotional neglect (“My father/mother never told me he/she loved me”), we added

five items of the *Emotional Neglect* scale of the CTQ, reverse coded for the purpose of analysis. To match the response categories of the CTS and CTQ, we used a 5-point scale ranging from 1 = *never* to 5 = *almost always* for all items. Cronbach's alphas for *Emotional Neglect* were excellent: $\alpha_{\text{mother}} = .94$, $\alpha_{\text{father}} = .91$.

To create a maltreatment history score, four scale scores (*Emotional* and *Physical Abuse*, and *Emotional* and *Physical Neglect*) were calculated from participants' self-reported experienced maltreatment by their parents. Scale scores were comprised of the highest score for father or mother (e.g., the highest score of *Emotional Abuse by father* and *Emotional Abuse by mother* was used to comprise the scale *Emotional Abuse*). Next, an overall *Abuse* score by averaging Emotional and Physical Abuse, and an overall *Neglect* score was comprised by averaging Emotional and Physical Neglect. In the same way, scale scores were calculated for their parents' self-reported maltreating behavior. On a scale ranging from (1) never to (5) (almost) always, average *Abuse* scores ranged from 1 to 4.5 and average *Neglect* scores ranged from 1 to 5. Because the distribution of the CTS data was skewed, scores were log-transformed and then multiplied by 10 to scale up the variance. There was one outlier ($n = 1$), which was winsorized, i.e., the difference between the two next highest values was added to the next highest value with standardized value < 3.29 (Tabachnik & Fidell, 2001) to fit the distribution.

Whenever possible, we combined information from two informants: participants (experienced childhood maltreatment) and their parents (perpetrated child maltreatment during their child's childhood). For 65 out of 160 participants at least two informants (participants and their parents) reported on experienced maltreatment. In these cases, *Abuse History* and *Neglect History* scores were calculated by averaging parent report and child reports of abuse and neglect. For 95 participants only self-report information on experienced maltreatment was available. Although convergence between parent- and child reported incidence of maltreatment can be modest (e.g., Compier-de Block et al., 2016), we choose to include information from multiple informants whenever possible to produce a more comprehensive picture. As a check, we did sensitivity analyses using only self-report data. These analyses yielded the same pattern of results for all outcomes, except for PEP. A summary of the model of PEP conducted with only self-report data can be found in the Supplementary material, Table S3.1.

Behavioral responses to infant cry and laughter sounds

An adult handgrip dynamometer was used to assess the use of excessive force during a standardized infant vocalizations paradigm (for a detailed description of the dynamometer and the derivation of the infant sounds, see Compier-de Block et al., 2015). Participants were first asked to practice maximally squeezing the handgrip dynamometer with their preferred hand several times, and were then asked to practice squeezing at 50% of their maximum grip strength. During the practice period participants could check

their performance on a monitor. Participants performed as many trials as necessary until they were able to modulate the force of their second squeeze to half the strength of their first squeeze. During the remainder of the task, the monitor was directed away from the participants.

The infant vocalizations paradigm was administered on a laptop using E-prime software. Participants were prompted to squeeze the handgrip dynamometer eight times at full and half strength, respectively, during a silent period (no sound) and while listening to infant cry and laughter sounds. The cry and laughter sounds were presented in counterbalanced order. Test-retest reliability for handgrip strength measurement has been shown to be adequate (.91 for men and .94 for women across a 10-week period; Reddon, Stefanyk, Gill, & Renney, 1985). Following previous studies (e.g., Compier-de Block et al., 2015) grip strength modulation was calculated by dividing the half-strength squeeze intensity by the full-strength squeeze intensity, so that scores of over 0.50 indicated excessive force on the half-strength squeeze attempt. Scores were then multiplied by 10 to scale up the variance. Data inspection revealed one outlier in the first and one in the second relative squeeze intensity during the no sound period, and one in the third relative squeeze intensity during laughter sound. These outliers were winsorized. Fourteen participants had missing data on one squeeze intensity (six during no sound, four during laughter, and four during cry), and one participant had missing data on three squeeze intensities (one during laughter sounds and two during cry sounds). These were imputed with the average of the other squeeze intensities of the participant in that particular episode (as was also done in Compier-de Block et al., 2015).

Perception of infant cry and laughter sounds

After each infant sound, participants rated their perception of the sound on four 5-point scales: not aroused–aroused, not urgent–urgent, healthy–sick, and not aversive–aversive (Zeskind & Lester, 1978). A Principal Component Analysis (PCA) on the four ratings for crying and laughter sounds pointed to one underlying component, explaining 53% and 57% of the variance, respectively. Factor loadings ranged from .63 to .84 for crying and from .67 to .83 for laughter. Therefore, the ratings were aggregated to obtain scores for the overall perception of the sound, for crying and laughter separately. Higher scores indicated a more negative perception of the sound. Cronbach's alphas were adequate (crying: $\alpha = .68$, laughter: $\alpha = .72$).

Autonomic responses to infant cry and laughter sounds

During the infant vocalizations paradigm, Electrocardiogram (ECG) signals and Impedance Cardiogram (ICG) signals were recorded using an ambulatory monitoring system (VU-AMS5 fs; TD-FPP, Vrije Universiteit, Amsterdam, the Netherlands). The ECG signal was recorded continuously using three disposable pre-gelled Ag–AgCl electrodes

(ConMed, New York, USA) that were attached below the right collar bone 4 cm to the right of the sternum, 4 cm under the left nipple and at the lateral right side. The ECG signal was recorded using four electrodes that were placed at the top end of the sternum between the tips of the collarbones, on the spine (at least 3 cm above the previous one), at the low end of the sternum where the ribs meet, and again on the spine (at least 3 cm under the previous one). E-prime had been programmed to send markers to the ECG and ICG recording during no sound, the presentation of each infant sound (crying and laughter) and the answering of the questions. To control for physical influences on the ECG and ICG data, participants were asked to refrain from alcohol and physical exercise for twenty-four hours prior to their visit at the laboratory.

The VU-DAMS software package derived interbeat interval time series (IBIs) by visual peak detection of the R-wave. The ECG recording was manually inspected and - if necessary - corrected in accordance with the VU-DAMS manual. Next, we attached labels to the data according to the markers sent by E-prime. PEP was scored manually from the ICG recording per labeled segment by the first author and two trained research assistants. Interrater reliability between all pairs of observers was adequate to excellent, with intraclass correlations (single measures, absolute agreement) ranging from .83 to .97. The respiration signal was obtained from filtered (0.1-0.4 Hz) thoracic impedance signal. The beginning and end of inspiration and expiration were detected by an automatic scoring algorithm. RSA was derived by the peak-valley method, which combined the respiratory time series and the interbeat intervals (IBI) to calculate the shortest IBI during HR acceleration in the inspiration phase, and the longest IBI during deceleration in the expiration phase (de Geus, Willemsen, Klaver, & van Doornen, 1995). RSA was defined as the difference between the longest and the shortest IBI. Scoring of the respiration signal and the IBI was done automatically. Average HR, PEP, and RSA were derived per labeled segment, i.e., 12 20-s intervals preceding each prompt to squeeze at full strength for squeezing during the no-sound condition, and during cry and laughter sounds (thus, the periods in which the participants squeezed at full and half strength were not coded). Subsequently, the mean within the segments was calculated per episode (no sound, cry, laughter) in SPSS. Prior to the infant vocalization paradigm, participants were presented with a series of landscape pictures for 2 min to measure resting autonomic activity. The no-sound condition, however, was used for comparison with the infant cry and laughter conditions to measure activity specific to emotional signals and in order to keep activity related to the use of hand-grip force constant.

Outliers were inspected per labeled segment as well as per aggregated episode. For both HR and PEP one participant showed outlying values for individual segments, which were winsorized. Combined episodes showed no outliers. Since RSA data were negatively skewed, these were logarithmically transformed. The log-transformed data were then multiplied by 10 to scale up the variance. Remaining outliers ($n = 3$) were winsorized.

Respiration rate was taken into account in analyses on RSA, as RSA is known to be susceptible to changes in breathing pattern (e.g., Bernardi, Porta, Gabutti, Spicuzza, & Sleight, 2001).

Analyses

To examine whether maltreatment experiences were associated with parents' resting autonomic activity, separate multiple regression analyses were run for HR, PEP and RSA, with experienced abuse and neglect as independent variables and age, gender and several lifestyle and disease factor entered as covariates. To examine the effects of infant crying and laughter sounds on participants' perceptions, autonomic responses, and behavioral responses, separate stepwise multilevel analyses were employed for each outcome measure. Multilevel modeling was used to match the hierarchical structure of the data: the measurements of perceptions, autonomic responses and behavioral responses were nested within individuals, while individuals were nested within families. Thus, three levels were specified: stimulus, person, and family level. Because of the large age range, and in accordance with previous studies on reactivity to infant sounds (e.g., Out, Bakermans-Kranenburg, van Pelt, & van IJzendoorn, 2012; Reijman et al., 2014), age and gender were included as covariates in all multilevel analyses. Additionally, pertinent lifestyle and disease variables (e.g., socio-economic status (SES), alcohol, smoking, exercise, heart medication, anti-depressants) were entered in the models on HR, PEP, and RSA, and omitted when p values exceeded .05.

For every outcome we started with an unconditional means model, which decomposed the variance in the outcome measures into three independent components, σ_e^2 , σ_{u0}^2 and σ_{v0}^2 (Model 1). This model was used to compute the intraclass correlation coefficient (ICC) at the family level ($\sigma_{v0}^2 / \sigma_{v0}^2 + \sigma_{u0}^2 + \sigma_e^2$) and the individual level ($\sigma_{u0}^2 / \sigma_{v0}^2 + \sigma_{u0}^2 + \sigma_e^2$). When the ICC at the family or individual level was (close to) zero and showed extremely large confidence intervals, that level was removed from the analysis. However, including the level did not affect the results. Gender and age were then added to the unconditional means model (Model 2). In the next step the *unconditional growth model - random intercept* only was tested, in which episode (dummy-coded with cry as the reference category) and order of presentation were added as predictors (Model 3). Next the *unconditional growth model - random intercepts and slopes* was tested (Model 4). Subsequently, experienced abuse and neglect were added as continuous predictors (Model 5). Based on this model, two separate analyses were run: one with experienced abuse and the interaction with episode and one with experienced neglect and the interaction with episode, to see whether this resulted in an improved model fit (Models 6 and 7). Multilevel regression analyses were fitted using the 'nlme' package (Pinheiro et al., 2017) in R (R Development Core Team, 2008). Likelihood ratio tests were used to evaluate whether model fit improved. Continuous predictors were centered around their mean.

Results

Participants included in the current study ($n=160$) were on average 45.8 years old ($SD = 10.0$, range: 28.8 - 69.7 years) and the sample was rather homogenous in terms of ethnicity: 96% of the participants were Caucasian. More females (58%) than males participated in the current study. The majority of participants (63%) had an advanced secondary school or vocational school diploma, 26% held a college or university degree, 5% had completed only elementary school or a short track of secondary school, and 6% of the participants did not report their education.

Preliminary analyses

As a check, we examined whether infant crying provoked more negative feelings than infant laughter. A paired comparison t -test revealed that the cry sound ($M = 10.04$, $SD = 2.45$) evoked significantly more negative feelings than the laughter sound ($M = 5.49$, $SD = 3.39$), $t(159) = 15.84$, $p < .001$.

Autonomic measures (HR, PEP, RSA) and the behavioral measure (handgrip force) correlated highly over the paradigm conditions. Correlations ranged from .86 - .98 for the autonomic measures and from .77 to .86 for handgrip force. Participants with higher HR during the entire paradigm had significantly lower RSA during the entire paradigm, with correlations ranging from -.47 to -.49. Higher HR was also related to shorter PEP during no sound ($r = -.18$, $p = .04$). Handgrip force was associated with RSA during no sound ($r = .19$, $p = .03$), laughter ($r = .22$, $p = .01$), and crying ($r = .21$, $p = .02$). More experienced abuse was related to more negative perceptions of infant laughter ($r = .16$, $p = .03$), and experienced neglect was negatively related to RSA during no sound, laughter and crying (correlations ranging from -.28 to -.29). See Supplementary material, Table S3.2 for a summary of the descriptive statistics and correlations.

Experienced neglect was positively associated with resting HR ($\beta = 0.26$, $t = 2.76$, $p = .007$), but not with resting RSA ($\beta = -0.15$, $t = -1.95$, $p = .053$) or resting PEP ($\beta = -0.08$, $t = -0.80$, $p = .45$). No associations were found between experienced abuse and resting HR, PEP or RSA ($ps > .17$). See Supplementary material, Table S3.3 for the multiple regression analyses on resting HR, PEP and RSA.

Perceptions

The results of the unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was close to zero for both the variance at the family level (< 0.001) and the individual level (< 0.001), indicating no dependency in the data. Therefore two multiple regression analyses were done for the perception of infant laughter and cry sounds, respectively, as dependent variables. For laughter, age, gender and order of presentation were included in the first step. This model explained 9% of the variance in

the perception of laughter sounds. In the second step experienced abuse and neglect were included as predictors. There was no significant increase in explained variance ($\Delta R^2 = .02$, $F(2,154) = 1.45$, $p = .24$). Experienced abuse and neglect were both not significantly associated with perception of laughter sounds, $\beta = 0.15$, $t = 1.69$, $p = .09$ and $\beta = -0.04$, $t = -0.44$, $p = .66$, respectively. For cry sounds, the first model with age, gender and order of presentation included, explained 8% of the variance in perception of cry sounds. Including experienced abuse and neglect in the second step did not result in a significant increase in the amount of explained variance ($\Delta R^2 = .02$, $F(2,154) = 1.40$, $p = .25$). Experienced abuse and neglect were not significantly associated with perception of cry sounds, $\beta = 0.14$, $t = 1.58$, $p = .12$ and $\beta = -0.01$, $t = -0.14$, $p = .89$, respectively. See Supplementary material, Table S3.4 for the multiple regression analyses on perceptions of cry and laughter sounds.

Autonomic responses

Heart Rate (HR)

The results of the stepwise multilevel model on HR are presented in Table 3.1. The unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was < 0.001 at the family level and 0.96 at the individual level, indicating high dependency at the individual level and no dependency at the family level. Because the variance of the family level was close to zero with an extremely large confidence interval, the family level variance was omitted from the model. Of the lifestyle and disease factors only alcohol use and physical exercise were significantly related to HR across the task. Caffeine, smoking, use of medication, hearing problems, and SES were not significantly related to HR across the task ($ps > .09$) and omitted from the model. Adding gender, age, physical exercise, and alcohol use as predictors to the intercept-only model (Model 2) resulted in an improved model fit ($\chi^2(4) = 21.08$, $p < .001$). In Model 3 episode and order of presentation were added as predictors, which further improved model fit ($\chi^2(3) = 28.47$, $p < .001$). This model showed a significantly higher HR during laughter than during crying ($t = 4.35$, $p < .001$), but no significant difference between no sound and cry ($t = -0.63$, $p = .53$). Adding a random slope did not significantly improve model fit ($\chi^2(5) = 5.19$, $p = .39$), therefore we continued with the unconditional growth model. Experienced abuse and neglect were added to this model (Model 4), which resulted in a significant model improvement ($\chi^2(2) = 7.90$, $p = .02$). Experienced neglect was significantly positively related to HR ($t = 2.58$, $p = .01$), meaning that participants who experienced more childhood neglect had a significantly higher HR than participants that experienced less neglect. See Figure 3.1, for an illustration of this finding. Experienced abuse was not significantly associated with HR ($t = .02$, $p = .93$). Lastly, adding the interactions between episode and experienced abuse and neglect did not significantly improved model fit for experienced neglect, $\chi^2(2) = 1.76$, $p = .41$ or abuse, $\chi^2(2) = 1.43$, $p = .49$ (not reported in Table 3.1). Therefore, Model 4 was accepted as the final model including only the main effects of experienced abuse and neglect.

Table 3.1. Mean heart rate (HR) and pre-ejection period (PEP) during infant sounds and experienced abuse and neglect

	Model 1	Model 2	Model 3	Model 4
HR				
Fixed effects				
Intercept	67.61 (0.87)***	76.68 (2.91)***	75.96 (3.85)***	76.42 (3.81)***
Age		-0.08 (0.09)	-0.07 (0.09)	0.17 (0.09)
Gender		1.38 (1.72)	1.40 (1.73)	1.51 (1.70)
Physical exercise		-2.78 (0.97)**	-2.86 (0.97)**	-2.85 (0.95)**
Alcohol use		-1.32 (0.46)**	-1.33 (0.47)**	-1.45 (0.46)**
Order			0.33 (1.63)	0.37 (1.63)
No sound - Cry			-0.11 (0.18)	-0.11 (0.18)
Laughter - Cry			0.79 (0.18)***	0.79 (0.18)***
Exp ^a Abuse				0.03 (0.80)
Exp Neglect				1.99 (0.77)*
Variance components				
Stimulus level Int ^b	2.40 (0.22)	2.39 (0.21)	2.16 (0.19)	2.16 (0.18)
Person level Int	102.01 (12.6)	87.04 (10.48)	87.23 (10.78)	82.08 (10.02)
Deviance	2165.13	2152.05	2129.58	2125.68
PEP				
Fixed effects				
Intercept	113.90 (2.01)***	109.41(3.09)***	119.89 (6.77)***	122.54 (6.81)***
Age		-0.04 (0.21)	-0.05 (0.21)	0.07 (0.23)
Gender		7.64 (4.05)	6.81 (4.04)	6.40 (3.99)
Order			-6.43 (3.96)	-7.87 (3.98)
No sound - Cry			-1.43 (0.51)**	-1.43 (0.51)**
Laughter - Cry			-0.60 (0.51)	-0.61 (0.51)
Exp ^a Abuse				3.30 (1.96)
Exp Neglect				-3.76 (1.88)*
Variance components				
Stimulus level Int ^b	17.72 (1.56)	17.72 (1.53)	17.22 (1.48)	17.22 (1.48)
Person level Int	538.24 (66.58)	523.50 (64.54)	507.15 (63.01)	489.29 (60.08)
Deviance	2912.36	2912.70	2908.18	2907.21

Note. Standard errors are in parentheses. Gender coded 0 = male, 1 = female. Order coded 0 = Laughter, 1 = Cry. Episode is dummy-coded in two dummies (No sound, Laughter) with Cry as the reference category. Because of extremely large confidence intervals for the variance at the family level, this level was removed from the analysis. Excluding variance at the family level did not influence the results. ^a Exp = experienced, ^bInt = intercept. * $p < .05$, ** $p < .01$, *** $p < .001$

Pre-ejection period (PEP)

The results of the stepwise multilevel model on PEP are presented in Table 3.1. The results of the unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was < 0.001 at the family level (with extremely large confidence intervals) and 0.96 at the individual level, indicating high dependency at the individual level and

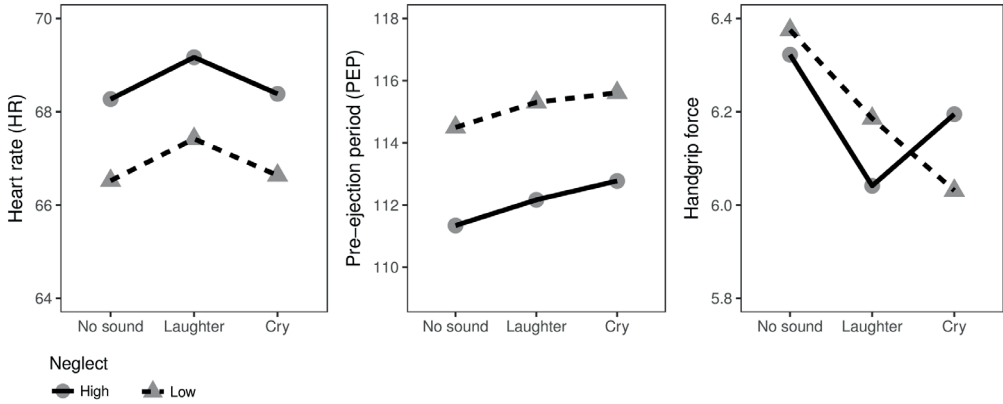


Figure 3.1.

Mean heart rate (HR), pre-ejection period (PEP) and handgrip force for each episode of the infant vocalizations paradigm, separately for different ratings for experienced neglect. For illustrative purposes participants were divided into two groups, a high and a low neglect group, based on a median split. A continuous score of experienced neglect was used in the multilevel analyses.

(almost) no dependency at the family level. We therefore omitted the variance at the family level and continued with a two-level model. None of the lifestyle and disease factors were significantly related to PEP across the task ($ps > .10$) and they were omitted from the model. Gender and age were added as predictors to the intercept only model (Model 2). Adding the covariates did not result in an improved model fit ($\chi^2(2) = 3.66$, $p = .16$). Model 3, with order and episode added as predictors, showed significantly better model fit than Model 2 ($\chi^2(3) = 10.52$, $p = .02$). Participants had a significantly shorter PEP during no sound than during cry ($t = -2.79$, $p = .006$). PEP during laughter was not significantly different from PEP during cry ($t = -1.18$, $p = .24$). Adding a random slope did not improve model fit ($\chi^2(5) = 1.77$, $p = .88$), therefore analyses were continued with the unconditional growth model (Model 3). In Model 4 experienced abuse and neglect were added as predictors, which tended to improve model fit ($\chi^2(2) = 4.97$, $p = .08$). Experienced neglect was significantly negatively associated with PEP ($t = -2.00$, $p = .047$), indicating that more experienced neglect during childhood was related to a shorter PEP. An illustration of this finding is provided in Figure 3.1. Experienced abuse was not significantly associated with PEP ($t = 1.63$, $p = .11$). Lastly, adding the interactions between episode and experienced abuse and neglect did not significantly improve model fit for experienced neglect, $\chi^2(2) = 2.02$, $p = .37$ or abuse, $\chi^2(2) = 0.12$, $p = .94$ (not reported in Table 3.1). Therefore, Model 4 was accepted, with only the main effects of experienced abuse and neglect, as the final model.

Respiratory sinus arrhythmia (RSA)

The results of the unconditional means model (Model 1) showed that the proportion of explained variance (ICC) was close to zero at the family level (with a large confidence interval) and 0.82 at the individual level. We therefore omitted the variance at the family level and continued with a two-level model. Of the lifestyle and disease factors only exercise was significantly associated with RSA. None of the other lifestyle and disease factors were significantly related to RSA ($p > .15$), and were omitted from the model. Gender, age, respiration rate and physical exercise were then added to the unconditional means model (Model 2), which resulted in improved model fit ($\chi^2(3) = 113.71, p < .001$). In the next step, order and episode were added the model (Model 3). There was no significant improvement of model fit ($\chi^2(2) = 3.51, p = .32$), meaning that RSA did not vary as a function of episode. In the next step experienced abuse and neglect were added (Model 3), which did not result in significant improvement of the model fit ($\chi^2(2) = 2.12, p = .35$). Moreover, the model showed no significant associations between experienced abuse and RSA, $t = -0.01, p = .99$ or experienced neglect and RSA, $t = -1.29, p = .24$. The interactions between episode and experienced abuse or neglect that were added in the next step did not significantly improve model fit for experienced neglect, $\chi^2(2) = 0.30, p = .86$ or abuse, $\chi^2(2) = 3.30, p = .19$. A summary of the model on RSA can be found in the Supplementary material, Table S3.5.

Behavioral responses

The results of the stepwise multilevel model on handgrip force are presented in Table 3.2. The unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.06 at the family level and 0.74 at the individual level. This indicated that a small amount (6%) of the variation in handgrip force was explained by differences between families and that a significant amount (74%) of the variation was explained by differences between individuals. Adding gender and age as predictors to the intercept-only model (Model 2) did not improve the model fit ($\chi^2(2) = 0.16, p = .90$). Episode and order of presentation were subsequently added to the model (Model 3), which resulted in an improved model fit ($\chi^2(3) = 12.67, p = .005$). Significantly more force was used during no sound than during crying ($t = 3.18, p = .002$), but force did not differ between the laughter and the no sound episode ($t = 0.23, p = .81$). Adding a random slope for laughter did not yield a reliable estimate, therefore only a random slope for no sound was specified in Model 4. This resulted in a significant model improvement from Model 3 to Model 4 ($\chi^2(2) = 12.45, p = .002$).

Table 3.2. Behavioral responses (handgrip force) to infant sounds and experienced abuse and neglect

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Fixed effects	Coef (se)	Coef (se)	Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept	6.21 (0.13)***	6.21 (0.19)***	5.95 (0.41)***	5.99 (0.41)***	5.96 (0.42)***	5.96 (0.42)***
Age		0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Gender		-0.01 (0.24)	-0.01 (0.24)	0.05 (0.24)	0.06 (0.24)	0.06 (0.24)
Order			0.11 (0.23)	0.06 (0.23)	0.07 (0.24)	0.07 (0.24)
No sound - Cry			0.24 (0.08)**	0.25 (0.08)**	0.25 (0.08)**	0.25 (0.08)**
Laughter - Cry			0.01 (0.08)	0.02 (0.07)	0.02 (0.07)	0.02 (0.07)
Experienced Abuse				-0.04 (0.11)	-0.04 (0.11)	-0.04 (0.11)
Experienced Neglect				-0.10 (0.11)	-0.10 (0.11)	-0.06 (0.11)
Experienced Neglect x No sound						-0.10 (0.06)
Experienced Neglect x Laughter						-0.15 (0.05)**
Variance components						
Stimulus level Intercept	0.46 (0.04)	0.46 (0.04)	0.44 (0.04)	0.34 (0.04)	0.34 (0.04)	0.30 (0.04)
Person level Intercept	1.77 (0.26)	1.77 (0.27)	1.77 (0.27)	2.07 (0.24)	2.07 (0.31)	2.07 (0.43)
Slope (No sound)						
Cov int/slope				0.30 (0.12)	0.30 (0.12)	0.32 (0.12)
Family level Intercept	0.14 (0.37)	0.13 (0.38)	0.13 (0.39)	0.18 (0.06)	0.20 (0.06)	0.18 (0.05)
Deviance	1304.44	1304.28	1297.61	1289.15	1291.82	1286.92

Note. Gender coded 0 = male, 1 = female. Order coded 0 = Laughter, 1 = Cry. Episode is dummy-coded in two dummies (No sound, Laughter) with Cry as the reference category.
 * $p < .05$, ** $p < .01$, *** $p < .001$

Next, experienced abuse and neglect were added as predictors (Model 5). Model fit did not significantly improve compared to Model 4 ($\chi^2(2) = 1.55, p = .46$), and experienced abuse and neglect were both not significantly related to handgrip force, $t = -.37, p = .72$ and $t = -.87, p = .38$, respectively. Lastly, adding the interactions between episode and experienced abuse, and between episode and experienced neglect in two separate analyses resulted in a significantly improved model fit for experienced neglect ($\chi^2(2) = 8.17, p = .016$, see Table 3.2), but not for experienced abuse ($\chi^2(2) = 2.43, p = .32$). Therefore, Model 6 with the inclusion of the interaction between experienced neglect and episode was accepted as the final model. The results of this model showed a significant interaction between experienced neglect and laughter ($t = -2.83, p = .005$), meaning that experiences of neglect were differently related to handgrip force during the cry and laughter episode. See Figure 3.1 for an illustration of this finding. Regression analyses for cry and laughter separately showed that more neglect was related to more handgrip force during infant crying (controlling for laughter, $\beta = 0.11, p = .03$) and to less handgrip force during infant laughter (controlling for crying, $\beta = -.13, p = .01$).

Discussion

In the current study we examined whether childhood maltreatment (physical and emotional neglect vs. physical and emotional abuse) experiences are negatively related to parents' emotion regulation and responses to infant signals across perceptual, physiological, and behavioral levels. Parents did not differ in their perceptions of infant crying and laughter according to their maltreatment experiences. In addition, a history of child abuse or neglect was not associated with autonomic *hyper*-reactivity to infant signals. However, a history of neglect was related to a higher HR and a shorter PEP during the entire infant vocalizations paradigm, which may be a sign of chronic cardiovascular arousal. Finally, experiences of neglect were differently related to modulation of handgrip force during listening to infant cry and laughter sounds.

Unexpectedly, parents did not rate the sounds differently according to their maltreatment experiences, which may seem to contradict previous research suggesting that parents with negative early caregiving experiences made more negative attributions about child emotional signals (Dykas & Cassidy, 2011; Leerkes & Siepak, 2006). However, in these studies participants were often asked to rate ambiguous child behavior. The infant vocalizations that were used in our study were unambiguously recognizable as infant happiness and infant distress. Therefore, our results indicate that maltreatment experiences do not influence processing of and responding to infant emotional signals on a conscious level.

However, we did find associations with experienced maltreatment on a physiological level. Although, unexpectedly, there was no evidence for ANS *reactivity* as a function of

maltreatment experiences, the results point to *chronic* autonomic activation as a result of maltreatment experiences. Conform our expectations, a history of neglect was associated with higher resting HR paralleled by a higher HR and a shortened PEP throughout the entire infant vocalizations paradigm, which suggests that parents with a history of neglect exhibited elevated autonomic arousal regardless of the specific demands of the environment. Since RSA was not associated with maltreatment experiences, findings may suggest that elevated autonomic activity in neglected parents is mainly driven by activation of the SNS – a hypothesis that should be tested in future studies because effect sizes for PEP were modest. Our findings regarding chronic autonomic arousal are in line with previous investigations that indicated that a history of maltreatment was associated with elevated autonomic activity as seen in less vagal regulation of the heart (i.e., higher RSA; Dale et al., 2009; Miskovic et al., 2009) and higher SCL (Casanova et al., 1994) even in the absence of specific stressors. Whereas ANS reactivity provides insight into parents' responsivity to a stressor, sustained autonomic activation may more generally reflect the capacity to regulate emotions (Brosschot, Pieper, & Thayer, 2005; Reijman et al., 2016). Thus, parental emotion regulation deficits may not only be manifest when dealing with infant distress, but may also be observable in non-parenting situations. The present findings are also in line with McEwen's (1998) theory of allostatic load, which posits that the ANS attempts to maintain stability through change during stressful conditions in order to maximize survival, a process referred to as allostasis. When the system is exposed to repeated or chronic stress, such as child maltreatment, physiological responses may become dysregulated, a process called allostatic load.

Experiences of neglect were differently related to modulation of handgrip force during listening to infant cry and laughter sounds: more neglect related to greater use of handgrip force during infant crying and less handgrip force during infant laughter. The link between neglect and more force during infant crying was in line with our hypothesis, and may indicate that parents with more experiences of neglect are more negatively aroused by infant distress, increasing the likelihood that they respond with harsh and aggressive behavior. This reasoning builds on prior arguments that aversion and anxiety may cause parents to punish infants for displaying negative affect in order to end the aversive stimulus (e.g., Out et al., 2010). The link between neglect and less force during infant laughter may indicate that parents with more experiences of neglect are less positively aroused by infant laughter. Infant laughter is a rewarding stimulus that generally elicits feelings of love and happiness from parents and reinforces parental playful interactions (Bowlby, 1969; Groh & Roisman, 2009). It is possible that negative childhood experiences, such as neglect, reduce the rewarding value of infant laughter and thereby diminish parental playful interactions. In a recent fMRI study it was found that experimentally induced oxytocin enhanced the incentive salience of infant laughter in individuals by modulating neural circuits related to emotion processing (Riem et al., 2012). Given that maltreated children have low levels of

oxytocin (e.g., Seltzer, Ziegler, Connolly, Prosoki, & Pollak, 2014), it is tempting to suggest that infant laughter may be less rewarding for parents who experienced neglect because of reduced oxytocin levels.

Remarkably, parents used more handgrip force and exhibited more SNS activity during the no sound condition than during infant sound conditions, while the 'no sound' condition is usually assumed to be the least stressful. Although instructions for the no sound part were similar to the other parts of the task, it was the first part of the task and participants may have felt most insecure about their performance. This may have resulted in increased arousal during this part of the task.

Lastly, we found associations between various domains of emotion regulation and a history of neglect, but no associations with a history of abuse. This might indicate that experiences of neglect have a more profound impact on emotion regulation skills in response to infant emotional signals than experiences of abuse. Although childhood neglect is a relatively understudied form of child maltreatment, it has been argued that childhood neglect has lasting, significantly negative consequences, equal to or even exceeding the long-term consequences of childhood abuse, because neglect tends to be more chronic (Hildyard & Wolfe, 2002).

We focused on child abuse and neglect from a continuous measurement perspective. In clinical and legal contexts, a dichotomization of child maltreatment may be used to decide whether to act or not to act, but for research purposes a cutoff is rather arbitrary. Moreover, measuring maltreatment in a continuous manner enabled us to examine a dose-response relationship between child maltreatment and outcomes in adults.

Unlike most previous studies, we included both sympathetic and parasympathetic measures to investigate the relation between maltreatment and autonomic functioning, rather than measuring the activity of just one system. In doing so, we followed the recommendations of Reijman and colleagues (2016) who argued for examining multiple autonomic measures to clarify the concept of physiological arousal. The inclusion of multiple autonomic measures increases the number of statistical tests, which in turn may increase the risk of type I errors. However, we tested a set of a priori specified hypotheses, and the outcome variables are considered to be different domains of emotion regulation and not alternative measures of the same phenomenon, which reduces the relevance of the type I error problem (e.g., Streiner & Norman, 2011). Moreover, multilevel modelling was used to test our hypotheses. Unlike the commonly used repeated measures analysis of variance, in which the point estimates are kept stationary, multilevel models shift point estimates and their corresponding intervals toward each other (by a process referred to as "partial pooling"). Multilevel estimates are thus more conservative in the sense that intervals for comparisons are more likely to include zero (Gelman, Hill, & Yajima, 2012).

The limitations of the current study should be noted. First, we acknowledge the potential limitations of retrospective reporting of childhood experiences. Participants may have

difficulty recalling childhood events (Edwards et al., 2001) or may be reluctant to disclose certain experiences or behaviors. A second limitation is the correlational design of the study, which precludes drawing causal inferences. Replication is needed in future studies with prospective and/or experimental intervention designs in order to more accurately isolate the effects of childhood maltreatment on adults' emotion regulation in response to infant emotional signals. Third, participants were exposed to cry and laughter sounds of unfamiliar infants in a laboratory context. Observations of parents' exposure to emotional signals of their own infants in a naturalistic setting would have increased the ecological validity. At the same time, it would have decreased the internal validity: the standardized design of the infant vocalization paradigm minimized the likelihood that the differences found between parents' emotional responses to infant signals are due to child factors.

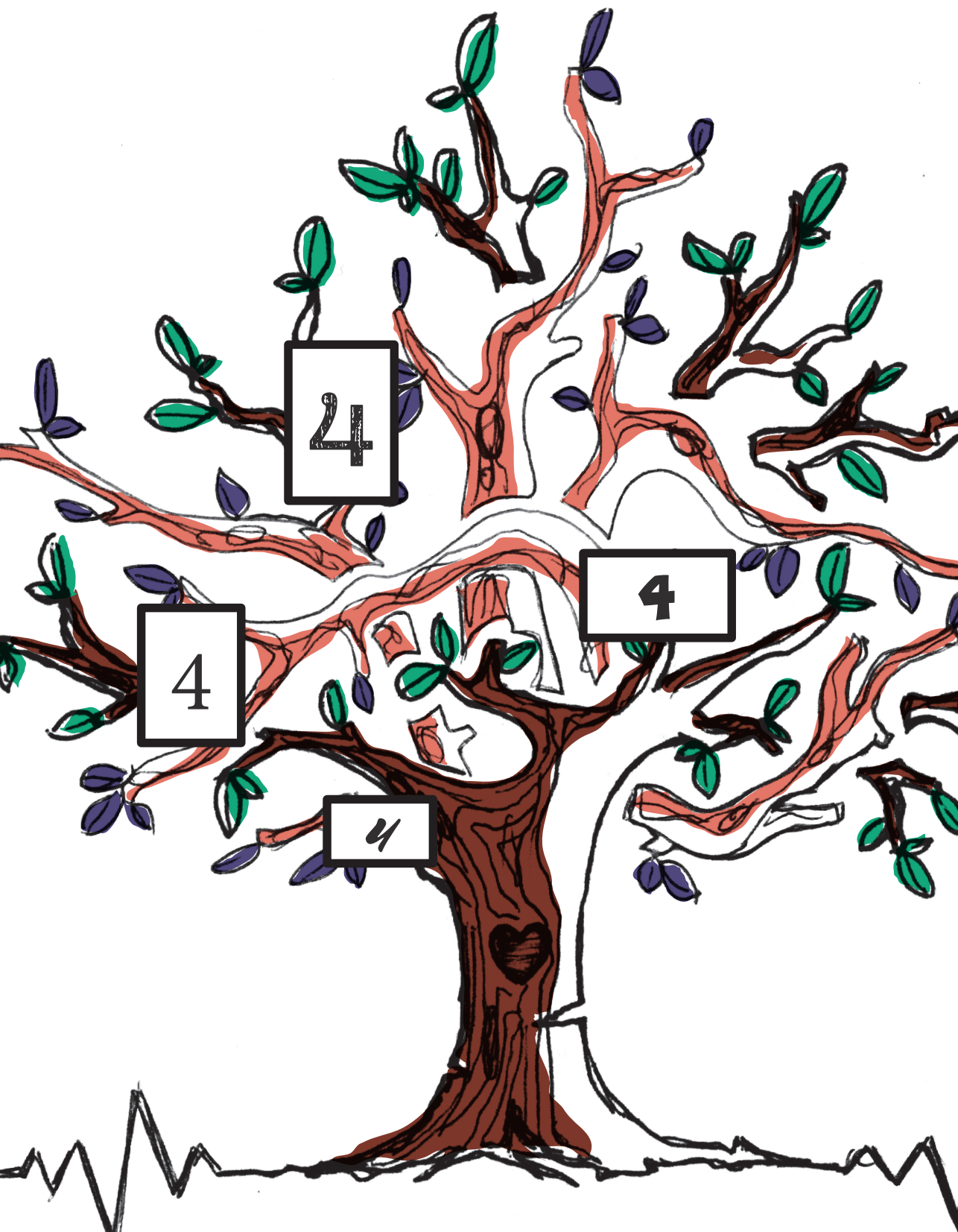
Taken together, we found evidence that parents who experienced neglect during their childhood show patterns of autonomic activity and behavioral responding to infant signals that are indicative of poor regulatory skills and that, in turn, may contribute to insensitive or even abusive caregiving (Compier-de Block et al., 2015; Joosen et al., 2013). Congruent with an attachment perspective, early attachment experiences may thus influence the development of emotion regulation strategies thought to be important for later adult adaptation (Bowlby, 1969). Together with the finding that parents' perceptions of infant emotional signals did not vary as a function of their maltreatment experiences, these results indicate that the effects of maltreatment on emotional responding to infant signals operate mainly at an unconscious level. The findings may provide a basis for intervention modules that help parents with a history of neglect become aware of their physiological and behavioral reactions and to successfully regulate their responses in order to promote sensitive parenting. Since neglect is a highly prevalent type of maltreatment (Stoltenborgh, Bakermans-Kranenburg, & van IJzendoorn, 2013) and sensitive parenting is crucial for children's socio-emotional development (e.g., Leerkes, Blankson, & O'Brien, 2009), such intervention modules may ultimately benefit the development of many children.

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4

Chapter 4

**Parents' experiences of
childhood abuse and neglect
are differentially associated
with behavioral and autonomic
responses to their offspring**

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Abstract

Although childhood maltreatment has been shown to compromise adaptive parental behavior, little is known what happens in terms of physiological regulation when parents with a history of childhood maltreatment interact with their offspring. Using a sample of 229 parents (131 women) the present study examined whether childhood maltreatment experiences are associated with parents' behavioral and autonomic responses while resolving conflict with their offspring. Self-reported experienced child maltreatment was measured using a questionnaire assessing abuse and neglect. Parents ($M_{\text{age}} = 52.7$ years, $\text{range}_{\text{age}} = 26.6$ to 88.4 years) and their offspring ($M_{\text{age}} = 24.6$ years, $\text{range}_{\text{age}} = 7.5$ to 65.6 years) participated in a videotaped parent-offspring conflict interaction task. Parental warmth, negativity and emotional support were coded. In addition, their pre-ejection period and respiratory sinus arrhythmia were measured as indicators of underlying sympathetic and parasympathetic nervous system reactivity, respectively. Findings demonstrated that experiences of abuse and neglect were associated with behavioral and physiological responses in different ways. Separating these two types of maltreatment in research and in clinical practice might be important.

Keywords: childhood maltreatment, parenting behavior, physiological reactivity, pre-ejection period, respiratory sinus arrhythmia

Introduction

Experiencing maltreatment during childhood imposes significant stress on children as for the child the caregiver is both the source of potential comfort and the source of threat and distress (Main & Solomon, 1990). Not surprisingly, childhood maltreatment experiences are associated with a wide range of negative consequences such as emotional and behavioral dysregulation in childhood (Cicchetti & Toth, 2005) and subsequent adverse mental health outcomes in adulthood (Jaffee, 2017). They have also been shown to compromise adults' interpersonal functioning including their parenting behavior (e.g., Pears & Capaldi, 2001). However, little is known about what happens in terms of physiological responses and regulation when parents with a history of childhood maltreatment interact with their offspring. Although physiological regulation and reactivity have been shown to be affected by childhood maltreatment experiences (e.g., Buisman et al., 2018; Casanova, Domanic, McCanne, & Milner, 1994), and are considered to underlie parenting quality (e.g., Bridges, 2008), empirical research on the link between parents' childhood maltreatment experiences and their physiological reactivity during real-time parent-offspring interactions is lacking. Furthermore, it may be important to distinguish between experiences of abuse versus neglect when examining the consequences of child maltreatment. Child neglect implies an act of *omission* and is related to the failure to meet the child's physical and emotional needs, whereas child abuse implies acts of *commission* which can be verbal or physical. Both abuse and neglect have been linked to maladjustment, yet it is still unclear whether abuse and neglect differentially impact behavioral and physiological systems (Gunnar & Quevedo, 2007). Accordingly, in an effort to expand the knowledge regarding childhood maltreatment and subsequent parenting behavior, the present research examines how parents' childhood experiences of abuse and neglect are associated with their physiological reactivity and parenting behavior – specifically warmth, negativity and emotional support, during a parent-offspring conflict interaction task.

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Childhood maltreatment history and parenting behavior: theoretical perspectives

Several perspectives may be useful to help explain the association between childhood maltreatment and later maladaptive parenting behavior. First, developmental psychopathology suggests that early childhood trauma impacts the quality of caregiving behaviors through stress or trauma-related symptoms that undermine caregiving capacities. Childhood maltreatment has been associated with heightened attentional and affective responses to fearful and angry faces, deficits in emotion recognition and reduced responsiveness to reward in children and adults (Jaffee, 2017). These distorted affective responses may compromise parents' capacity to respond in an appropriate way to their children's emotional needs and behaviors.

Attachment theory has also proposed explanations for linkages between childhood maltreatment and subsequent parenting difficulties. According to Bowlby (1969, 1973, 1980) children develop 'internal working models' (i.e., mental representations) of the self and others through repeated interactions with their primary caregiver(s), from which they then interpret and experience other relationships, including the relationship with their own offspring. In line with this proposition, empirical research has shown that adults who experienced childhood maltreatment were more likely to form insecure working models (Raby, Labella, Martin, Carlson, & Roisman, 2017), and insecure working models in turn have been associated with maladaptive caregiving (Dykas & Cassidy, 2011; Reijman et al., 2017).

According to social learning theory, behavior is learned in large part through observation, imitation, and reinforcement (Bandura, 1973). It postulates that violence is learned through role models provided by the family either directly or indirectly (i.e., witnessing violence), is reinforced in childhood, and continues in adulthood as a coping response to stress or as a method of conflict resolution. Support for this theory comes from studies that showed that the experience of violence in childhood is associated with general patterns of violent behavior (e.g., Widom 1989), as well as later violence in close relationships (e.g., Ehrensaft et al., 2003; Pears & Capaldi, 2001).

Finally, at a neurobiological level, chronic childhood maltreatment is thought to increase allostatic load (Cicchetti & Toth, 2005). According to McEwen's (1998) theory of allostatic load, the autonomic nervous system (ANS) attempts to maintain stability through change during stressful conditions in order to maximize survival, a process called allostasis. When the system is exposed to repeated or chronic stress, including child maltreatment, physiological responses may become dysregulated, a process referred to as allostatic load. Two common patterns of allostatic load are *hyper-* and *hypo-*arousal. A *hyper-*arousal response pattern is characterized by heightened physiological activity and dampened physiological recovery in response to a stressful event. A *hypo-*arousal response pattern is denoted by dampened physiological activation to environmental stress and challenge. Both patterns of allostatic load are thought to diminish parental capacity to call upon effective parenting behaviors and strategies (Bridges, 2008; Sturge-Apple, Skibo, Rogosch, Ignjatovic, & Heinzelman, 2011).

Childhood maltreatment history and parenting behavior: empirical research

A number of empirical studies have investigated the association between childhood maltreatment and later parenting. Studies using self-report measures of parenting behavior revealed that child maltreatment is associated with maladaptive parenting outcomes including lower perceived parenting competence, more parenting stress, more role reversal, decreased responsivity, more harsh physical discipline, and more abusive and neglectful parenting behaviors (Alexander, Teti, & Anderson, 2000; Banyard, 1997;

Bennett, Sullivan, & Lewis, 2006; Bert, Guner, & Lanzi, 2009; Dilillo & Damashek, 2003; Heyman & Smith Slep, 2002; Lang, Gartstein, Rodgers, & Lebeck, 2010). However, it is questionable whether parents' subjective estimation of their parental behavior reflects their actual parental functioning, because their reports may be biased by their ability to accurately reflect on and describe their interpersonal behavior (Bailey, Moran, & Pederson, 2007; Chiesa & Fonagy, 2014). Indeed, convergence between self-reported and observed parental interactive behavior with their offspring is typically low, particularly in mothers from high-social-risk populations (Bailey, DeOliveira, Wolfe, Evans, & Hartwick, 2012; Bennett et al., 2006; Fitzgerald, Shipman, Jackson, McMahon, & Hanley, 2005). As opposed to self-reports of parenting, observational measures of parenting are considered to be less influenced by bias (Gardner, 2000) and have been shown to be stronger and more consistent predictors of offspring outcomes (Zaslow et al., 2006).

In their literature review, Vaillancourt and colleagues (2017) identified fourteen studies on the association between maternal experiences of childhood physical and sexual abuse and observed parent-infant interactions. Of these fourteen studies, ten showed that childhood abuse experiences were, directly or indirectly, associated with maternal interactive behavior, including hostile, intrusive, and inconsistent behavior towards infants. The available research on childhood maltreatment history and observed parent-offspring interactions with children during later developmental stages (toddlerhood and middle childhood) revealed that mothers' history of childhood maltreatment was associated with less sensitive, more hostile and more self-focused behavior (Bailey et al., 2007; Burkett, 1991; Pasalich, Cyr, Zheng, McMahon, & Spieker, 2016; Rahma, Alsarhi, Prevoo, Alink, & Mesman, 2018). Studies on childhood maltreatment and observed parental interactions with offspring beyond middle childhood are – to our knowledge – lacking, even though the parent-offspring relationship constitutes one of the most long-lasting social relationship and continues to be of importance in the lives of most adults (e.g., Trommsdorf, 2006). In addition, the majority of studies did not include any fathers, whereas fathers' involvement in child care has continuously increased in many western countries the past few decades (Jones & Mosher, 2013; World Health Organization (WHO), 2007). Finally, among the set of studies with observational measures, most investigated the impact of physical abuse, leaving the question open whether the effects also hold true for other types of maltreatment such as emotional or physical neglect. In the current study we therefore examined the impact of childhood abuse *and* neglect in maternal as well as paternal interactions with offspring spanning a wide age range.

Continuity in parent-offspring interactions

While transitions from childhood to adolescence and from adolescence to adulthood may generate changes in parent-offspring relationships (e.g., Buhl, 2007; McGue, Elkins, Walden, & Iacono, 2005), research also points to continuity in parent-offspring

relationships. For example, both social learning theory (Bandura, 1973) and attachment theory (e.g., Bowlby, 1969; Ainsworth, 1989) assume that interaction patterns learned and enacted during childhood and adolescence will continue to manifest themselves in young adults' relationships. In accordance with these perspectives, parent-offspring relationships during childhood are predictive of parent-offspring relationships during adolescence and adulthood (e.g., Aquilino, 1997; Belsky, Jaffee, Hsieh, & Silva, 2001; Dalton, Frick-Horbury & Kitzmann, 2006; Whitbeck et al., 1994). Specifically, more warmth, intimacy, and cohesion during childhood and adolescence have been associated with more emotional closeness, support, and contact with parents during early adulthood (e.g., Aquilino, 1997; Belsky et al., 2001). In contrast, more conflict with parents during adolescence has been associated with more conflict with parents during young adulthood (Aquilino, 1997). Thus, to a certain extent, parental interactions with their underage offspring show continuity in their interactions with their adolescent and adult offspring.

Childhood maltreatment history and autonomic reactivity

Studies that include autonomic nervous system activity measures may provide insight into the mechanisms underlying the effects of childhood maltreatment experiences on parenting behavior. The autonomic nervous system (ANS) is part of the peripheral nervous system that is responsible for regulating the internal organs and glands (Larsen, Schneiderman, & De Carlo, 1986). The ANS consists of two subsystems: the parasympathetic nervous system (PNS) and the sympathetic nervous system (SNS). Generally, the SNS mobilizes the body's fight-or-flight response, whereas the PNS controls homeostasis and the body's rest-and-digest response. Thus, stress typically activates the SNS while the PNS is inhibited (Michels et al., 2013; Viamontes & Nemeroff, 2009). A general measure to monitor changes in cardiac SNS activity is the PEP, which is determined by systolic time intervals and reflects cardiac contractility (Newlin & Levenson, 1979). The degree of cardiac control by the PNS is commonly assessed as the amplitude of respiratory sinus arrhythmia (RSA; Porges, 1995). RSA is an indirect measure of vagal tone, which reflects parasympathetic influence on the heart via the vagus nerve, a cranial nerve pertaining to the PNS. Therefore, in a typical response to stress, PEP decreases due to shortening of the systolic period and RSA decreases due to cardiac vagal withdrawal.

Studies that focused on the association between childhood maltreatment and ANS reactivity to psychosocial stressors mainly reveal physiological *hyper*-reactivity in response to stressors (i.e., overarousal) following childhood maltreatment (e.g., Heim et al., 2000; Dale et al., 2009), but *hypo*-reactivity (i.e., underarousal) has also been found (e.g., Ginty, Masters, Nelson, Kaye, & Conklin, 2016). In addition, three studies examined the impact of (stress inducing) infant emotional signals on parental ANS reactivity (Buisman et al., 2018; Casanova et al., 1994; Reijman et al., 2014). Casanova et al. (1994) found that mothers with a history of childhood abuse exhibited increases in skin conductance (reflecting increased SNS

activity) while viewing a video of a smiling infant, but not while viewing a video of a crying infant. The opposite pattern was observed for mothers without a history of abuse. This may indicate that mothers with a history of abuse are less sensitive to child negative emotional states. Another study on maltreatment and autonomic reactivity revealed that PEP recovery values (i.e., values during a 4-min baseline of neutral images after exposure to infant cry sounds) decreased in non-maltreating mothers with few maltreatment experiences, whereas they increased in non-maltreating mothers with extensive maltreatment experiences (Reijman et al., 2014). For maltreating mothers PEP recovery did not vary as a function of their experienced maltreatment. The authors suggest that having experienced extensive maltreatment may result in a maladaptive PEP recovery pattern that is similar to that of maltreating mothers. Finally, Buisman and colleagues (2018) found no evidence for altered ANS reactivity to infant emotional signals following childhood neglect, but did find that childhood neglect experiences were associated with a higher heart rate and a shorter PEP during the entire infant vocalization paradigm, which may indicate chronic cardiovascular *hyper-*arousal (Brosschot, Pieper, & Thayer, 2005). Contrary to ANS reactivity, which may indicate responsivity to distress, sustained (i.e., basal) ANS activation may more generally represent the capacity for emotion regulation (Appelhans & Luecken, 2006). In conclusion, studies have shown differential ANS regulation and reactivity to psychosocial and attachment-related stressors following maltreatment. Yet, empirical research on the link between child maltreatment experiences and parents' ANS reactivity in the context of stressful parent-offspring interactions is lacking. More insight into what happens 'under the skin' when parents with a history of childhood maltreatment interact with their offspring may help researchers and practitioners better understand how maladaptive parenting behaviors are transmitted from one generation to the next.

Autonomic reactivity and parenting behavior

Neurobiological frameworks underscore the significance of irregularities in physiological system functioning in shaping individuals' interactions with significant others, and thus provide a foundation for associations with maladaptive parenting behaviors (Bridges, 2008). Research examining parental ANS functioning during stressful parent-offspring contexts provides some empirical support for an association between physiological dysregulation and maladaptive parenting behavior, particularly regarding PNS activity. For example, Lorber & O'Leary (2005) found that mothers who displayed harsh discipline with their preschool children during a task designed to elicit challenging toddler behavior showed corresponding decreases in RSA (i.e., PNS withdrawal). RSA decreases, however, have also been associated with adaptive parenting behavior. For example, a greater degree of maternal PNS withdrawal has been associated with more sensitive (Moore et al., 2009) and less negative intrusive parenting behavior (Mills-Koonce et al., 2009) during parenting challenges. Studies thus indicate mixed results on the association between

autonomic reactivity during parenting and the quality of parenting behavior, and – to our knowledge – this association has not yet been examined using indicators of the SNS. Such research is therefore needed to further our understanding of the psychophysiology of real-time parenting behaviors.

The current study

In order to gain further insight into the link between childhood maltreatment experiences and subsequent parenting, the present study examined associations between parents' childhood maltreatment experiences and their autonomic and behavioral reactivity during a parent-offspring conflict interaction task that has been shown to elicit stress responses in previous studies (e.g., Beijersbergen, Bakermans-Kranenburg, Van IJzendoorn, & Juffer, 2008; Eisenberg et al., 2008). We hypothesized that parents who experienced childhood maltreatment (physical & emotional neglect and physical & emotional abuse) would show less warmth and emotional support and more negativity during the parent-offspring conflict interaction task. Furthermore, we hypothesized that parents with childhood maltreatment experiences were more likely to exhibit autonomic *hyper*-reactivity (PEP and RSA decreases) during the parent-offspring conflict interaction task. We also hypothesized that parental behavior and autonomic reactivity would be interrelated. However, due to mixed findings from previous studies, no specific hypotheses were made regarding the directions of the associations. Furthermore, since research has shown that ANS dysregulation follows childhood maltreatment experiences (e.g., Heim et al., 2000) and may also underlie maladaptive parenting (Bridges, 2008), ANS dysregulation may act as a mechanism in the association between childhood maltreatment experiences and parenting. Although measured concurrently, in case of significant associations between ANS reactivity and parenting, we also explored whether ANS reactivity mediated the association between childhood maltreatment experiences and parenting. Finally, we tested whether childhood maltreatment experiences were associated with basal autonomic activity, and we hypothesized that childhood maltreatment experiences would be associated with overall sustained physiological arousal.

Method

Sample

Recruitment

The current sample was part of a larger sample from the 3G parenting study, a family study on the intergenerational transmission of parenting styles, stress and emotion regulation (see also Compier-de Block et al., 2016; Buisman et al., 2018). Participants of the 3G parenting study were recruited from three participant pools: (1) The Netherlands Study of Depression

and Anxiety (NESDA; Penninx et al., 2008), (2) the Longitudinal Internet Studies for the Social Sciences (LISS panel; Scherpenzeel, 2011) and (3) a study on parenting (Joosen, Mesman, Bakermans-Kranenburg, & van IJzendoorn, 2013). From two of these studies we recruited participants who reported having experienced some form of maltreatment during their childhood, and from the third study all participants were invited. In order to protect the privacy of our participants we cannot disclose from which study we recruited maltreated participants. The participants from these three studies served as target participants. In total, 63 participants from different families agreed to take part in the 3G parenting study. After their consent, we invited their family members (parents, partners, children, adult siblings, nephews, nieces and in-laws) to participate as well. Family members had to be at least 7.5 years of age to be invited. Families were included if at least two first-degree relatives from two generations were willing to participate. This resulted in a total of 395 participants from 63 families with two to four generations and an average of 6.27 family members per family (range: 2 to 23), who agreed to participate in the 3G parenting study.

Participants

Parents with offspring who were at least 7.5 years of age ($n = 229$) were eligible for the conflict interaction task (i.e., revealed differences task, Strodbeck, 1951) and were included in the current study. Parents whose offspring did not participate, but with data on experienced maltreatment, baseline autonomic activity and demographic covariates were included in the analyses. Participants (131 women, 98 men) were on average 52.7 years of age (range: 26.6 - 88.4 years) and were mainly Caucasian (97%). The majority of participants (66%) had an advanced secondary school or vocational school diploma, 25% held a college or university degree, 7% had completed only elementary school or a short track of secondary school, and 2% of the participants did not report their education. Participating offspring ($n = 306$) were on average 24.6 years of age (range: 7.5 – 65.6). Approximately half of the parents ($n = 111$) completed the interaction task with multiple offspring. For these parents we selected the data of the interaction task that was done with the offspring whose age was closest to the mean age of the offspring in order to reduce the variance in offspring's age. Out of 229 participants, 30 (13%) participated both as parent and as offspring in the conflict interaction task.

Procedure

Nuclear families were invited for a 7-hour lab visit at the Leiden University Medical Centre. Participants with offspring visited the lab twice – once with their family of origin (parents and siblings) and once with their partner and offspring. A lab visit involved questionnaires, computer tasks, family interaction tasks, collection of saliva and hair samples, and during specific tasks skin conductance and heart rate were measured. Eligible participants were also invited for a functional magnetic resonance imaging (fMRI) session. Informed

consent was obtained from all participants. Ethical approval was obtained from the Ethics Committee of the Leiden University Medical Centre. Data collection took place from March 2013 to May 2016.

Measures

Demographic information

Age, gender and socio-economic status (SES) were included as background variables. Participants filled out a questionnaire with questions about household income and highest completed education. Yearly household income was measured on a 7-point scale ranging from (1) less than € 15,000 to (7) more than € 65,000. Education was also rated on a 7-point scale. Based on standardized household income and standardized completed educational level a composite SES score was calculated.

Childhood maltreatment

Childhood maltreatment was measured using subscales of the Parent-Child Conflict Tactics Scales (CTS-PC; Straus, Hamby, Finkelhor, Moore, & Runyan, 1998) and the CTQ. Participants completed questions about experienced child maltreatment before the age of 18 years by their father and mother separately. If participating in the study, their parents filled out a version in which they were asked whether they had conducted maltreating behaviors towards their offspring before they had reached the age of 18 years. Parent-report information on maltreatment was available for only 27% of the participants. We therefore decided to run all analyses with self-report information on experienced maltreatment in the main analyses. As a check, we conducted sensitivity analyses using a multi-informant score for which – if available – the information from participants and their parents was combined. Analyses using the multi-informant score yielded similar parameter estimates for the models.

To match the response categories of the CTS and CTQ, we used a 5-point scale for both questionnaires ranging from 1 = *never* to 5 = *almost always* for all items. The combined questionnaire consisted of four subscales. *Psychological aggression* (i.e., emotional abuse; CTS-PC) was comprised of 5 items (e.g., “Shouted, yelled, or screamed at me”). Cronbach’s alphas were adequate: $\alpha_{\text{mother}} = .81$, $\alpha_{\text{father}} = .74$. *Physical Assault* (i.e., physical abuse; CTS-PC) was comprised of 13 items, including corporal punishment (5 items, e.g., “Being spanked on the hand, arm or leg with a bare hand”), severe assault (4 items, e.g., “Being hit with a fist or kicked hard”), and very severe assault (4 items, e.g., “Being burned or scalded”). Cronbach’s alphas for *Physical Assault* were excellent: $\alpha_{\text{mother}} = .91$, $\alpha_{\text{father}} = .91$. The *Emotional Neglect* scale included one item from the CTS-PC and five items from the CTQ, which were reverse coded for the purpose of analysis (e.g., “My father/mother never told me he/she loved me”). Cronbach’s alphas for *Emotional Neglect* were excellent: $\alpha_{\text{mother}} = .94$, $\alpha_{\text{father}} = .92$.

The *Physical Neglect* scale (CTS-PC) consisted of 4 items (e.g., "My father/mother was not able to make sure I got the food I needed"). Cronbach's alphas were adequate: $\alpha_{\text{mother}} = .68$, $\alpha_{\text{father}} = .61$.

Total 'abuse' and 'neglect' history scores were calculated from the four subscale scores (Emotional and Physical Abuse, and Emotional and Physical Neglect) of parents' self-reported experienced maltreatment. Scale scores were made up of the highest score for mother or father (e.g., the highest score of *Emotional Abuse by mother* and *Emotional Abuse by father* was used as score for *Emotional Abuse*). Next, an overall Abuse score was created by averaging Emotional and Physical Abuse, and an overall Neglect score was created by averaging Emotional and Physical Neglect. Pearson correlations revealed significant correlations between Emotional and Physical Abuse ($r(229) = .71, p < .001$) and Emotional and Physical Neglect ($r(229) = .42, p < .001$).

Because the distribution of the CTS data was skewed to the right, scores were log-transformed and then multiplied by 10 to scale up the variance.

Parental behavior during a parent-offspring conflict interaction task

Using a parent-offspring conflict interaction task, also known as revealed differences task (Strodtbeck, 1951), we investigated the patterns of interaction between parents and offspring. This conflict interaction task has been used in previous research exploring individual functioning and has proven to be a meaningful index of both parenting behavior as well as physiological arousal and regulation (Beijersbergen et al., 2008; Eisenberg et al., 2008). A dyad, consisting of a parent with one offspring at a time, was asked to discuss and try to reach consensus on an issue on which they disagreed. Participants were each asked to fill out a questionnaire listing common parent-offspring discussion topics (e.g., underage offspring: bedtime, homework; adult offspring: raising grandchildren, time spent with family) and to select five topics that had been discussed most often during the past month. In addition, they were asked to indicate how they felt discussing these topics. Based on this information, a research assistant selected the two topics that participants felt most strongly about, preferably topics that were reported by both parent and offspring as something they often discussed at home. The dyads were then brought to a separate room and were instructed to discuss the topics for 10 minutes and to try to reach consensus. The interactions were filmed and there were no other people in the room during the interactions.

The interactions were coded with The Supportive Behavior Task Coding Manual, Version 1.1 (Allen et al., 2001). Minor adaptations (clarification and fine tuning of constructs) were made to the coding system to fit the current study. Parents and offspring received scores for *Warmth*, *Negativity* and *Emotional support*. *Warmth* deals with the extent to which a person demonstrates warmth towards the other that they care about the other, value, and genuinely like the other. This includes verbal expressions (e.g., verbally empathizing),

a warm tone of voice, warm facial expressions, and body postures/behaviors showing warmth and a sense of building the relationship (e.g., touching). The 9-point rating scale ranged from (1) no signs of warmth (i.e., 'You can't tell if the person likes or cares about the other') to (9) clear signs of warmth (i.e., 'The participants' behavior overall gives a warm feeling to the interaction'). *Negativity* captures the level and persistence of tension, hostility, dissension, or antagonism directed at the conversational partner. Examples of negativity are stonewalling, negative statements of the other, eye rolling, loud sighing, interrupting the other and negative teasing (sarcasm). Negativity was rated on a 9-point rating scale ranging from (1) demonstrations of negativity are absent to (9) the person is very negative (i.e., 'The negativity endures throughout the discussion and is disruptive to the interaction.'). Negativity scores were skewed to the right and therefore logarithmically transformed. *Emotional support* represents the amount of support that a person gives to the other to indicate an understanding or support of the feelings of the other person, through naming the emotion, recognizing the feelings, sympathizing (e.g., 'I'm sorry you feel that way'), or eliciting emotional information. The 9-point rating scale ranged from (1) absence of emotional support (i.e., 'No attempts to emotionally support the other person are made.') to (9) high emotional support (i.e., 'The supporter clearly recognizes the other's emotional distress and makes clear attempts to draw the other out').

In addition, we coded *Discussion of a problem* and *Supportive role*. During the interaction task, some dyads discussed topics that were not seen as problems. *Discussion of problem* was coded on a dichotomous scale where 0 indicates the absence of discussing a problem and 1 indicates that a problem was discussed. *Supportive role* captures the extent to which a person was expected to be supportive during the conversation. This code was added because conversational partners sometimes do not disclose any emotional information and therefore the other partner is not expected to respond in an emotionally supportive way (i.e., there is no information to respond emotionally supportive to). A score of 1 was assigned when the parent disclosed no emotional information (only the offspring disclosed emotional information) during the conversation and a score of 0 when parents disclosed emotional information.

The interactions were coded by the first author and three trained research assistants. The two participants of the dyad were coded independently. Coders were blind to maltreatment history and maltreatment perpetration of the individual they coded, as well as to the scores of the individual in interaction with other family members. Extensive training in using the coding system was given by the first and last author of this manuscript. After training 20 videos (40 individuals) were coded to assess reliability. Then a period of five months followed in which videos were coded individually. During biweekly meetings videos were discussed in order to minimize observer drift. In addition, halfway the coding period another set of 20 videos were coded, which resulted in a total reliability set of 40 video's (80 individuals). Interrater reliability between all pairs of observers was adequate

to good, with intraclass correlations for the separate pairs (ICCs; single measures, absolute agreement) ranging from .71 to .82 for *Warmth*, .66 to .78 for *Negativity* and .72 to .80 for *Emotional Support*. Cohen's Kappa showed perfect interrater reliability ($k = 1.0$) for *Discussion of a problem* and good interrater reliability ($k_{\text{range}} = .70 - .80$) for *Supportive role*.

Each dyad consisted of a parent and an offspring (who could be an adult as well). Because the focus of the current study was on parental physiological and behavioral responses we decided to only use the scores of the parents in the analyses. Of the 229 parents, interactions of 9 parents were missing because their children did not participate in the study, and interactions of 11 parents were lost because of technical problems with recording the interaction. Moreover, scores of parents were excluded when no problem was discussed ($n = 8$).

Autonomic (re)activity

Before and during the conflict interaction task, Electrocardiogram (ECG) signals and Impedance Cardiogram (ICG) signals were recorded using an ambulatory monitoring system (VU-AMS5 fs; TD-FPP, Vrije Universiteit, Amsterdam, the Netherlands). The ECG signal was recorded continuously using three disposable pre-gelled Ag-AgCl electrodes (ConMed, New York, USA) that were placed below the right collar bone 4 cm to the right of the sternum, 4 cm under the left nipple and at the lateral right side. To record the ICG signal, four electrodes were placed at the top end of the sternum between the tips of the collarbones, on the spine (at least 3 cm above the previous one), at the low end of the sternum where the ribs meet, and again on the spine (at least 3 cm under the previous one).

With the VU-DAMS software package, Interbeat interval time series (IBIs) were obtained by visual peak detection of the R-wave. We inspected each ECG recording and corrected it manually when necessary in line with VU-DAMS instructions. From each ICG recording, PEP was scored manually for the baseline task and the interaction task by the first author and a trained research assistant. Interrater reliability (ICC; single measures, absolute agreement) on 40 cases was excellent (ICC = 0.96). The respiration signal was obtained from filtered (0.1-0.4 Hz) thoracic impedance signal. An automatic scoring algorithm identified the beginning and end of inspiration and expiration. Subsequently, RSA was obtained via the peak-valley method that combines the respiratory time series and the interbeat intervals (IBI) to calculate the shortest IBI during HR acceleration in the inspiration phase, and the longest IBI during deceleration in the expiration phase (De Geus, Willemsen, Klaver, & Van Doornen, 1995). RSA was defined as the difference between the longest and the shortest IBI. Scoring of the respiration signal and the IBI was done automatically. RSA values were logarithmically transformed because of a skewed distribution.

Prior to the interaction task, participants were presented with a series of neutral pictures and were asked to describe them for two minutes to measure resting autonomic activity. This baseline task was chosen because participants speak during the interaction task and

speech has been shown to affect PNS and SNS measures (e.g., Bernardi, Porta, Gabutti, Spicuzza, & Sleight, 2001; Sloan, Korten, & Myers, 1991) due to alterations in the respiratory cycle while speaking and to motor activity in the face and throat. For the evaluation of autonomic reactivity to the interaction task a residualized change score was computed by regressing PEP and RSA scores during the interaction task on PEP and RSA scores during baseline. The residuals were then used as measures of RSA and PEP reactivity, respectively. Residualized change scores are referred to as “base-free” measures of change and avoid some of the reliability concerns with difference scores (MacKinnon, 2008). Lower residualized change scores for RSA and PEP indicate greater PNS withdrawal and SNS activation from baseline to task, respectively.

As with the behavioral measures, only parent's physiological responses were examined in the current study. We checked for outliers in the distribution of baseline scores, interaction task scores, and the residualized scores. For RSA one participant showed an outlying values during baseline, which was winsorized, i.e., the difference between the two next highest values was added to the next highest value with standardized value < 3.29 (Tabachnik & Fidell, 2001). For PEP, two participants showed outlying values for the residualized change score, which were winsorized as well. Due to technical problems, autonomic activity scores were missing during baseline and the interaction task for eight and 20 participants, respectively. Furthermore, eight participants had missing autonomic activity scores because of heart conditions incompatible with electrocardiogram analysis, and an additional 10 participants had no data for PEP because of flat impedance cardiograms (ICGs).

Physical exercise and smoking

Physical condition and smoking may influence HR (De Geus, Boomsma, & Snieder, 2003; Hayano et al., 1989). We therefore asked participants whether they had engaged in physical exercise or sports in the previous week, and whether they smoked or not.

Analyses

Pearson correlations between maltreatment, parental interactive behavior and autonomic (re)activity were computed. Subsequently, we computed a structural model using the package *lavaan* (Rosseel, 2012) in R (R Core Team, 2013) to estimate the associations between experienced maltreatment, parental interactive behavior and autonomic reactivity during the interaction task. Age, gender, and SES were included as covariates to ensure that demographic information did not confound the results. Supportive role was included as a covariate for emotional support. Moreover, respiration rate was taken into account for RSA, as RSA is susceptible to fluctuations in breathing pattern (Bernardi et al., 2001). Finally, smoking and physical exercise were included in the regression equations for autonomic reactivity and excluded when *p* values exceeded .05.

Twelve percent of all values were missing, with missingness rates per variable ranging from 0 to 24%. Little's Missing Completely at Random (MCAR) test was not significant ($\chi^2 = 113.71$, $df = 111$, $p = .411$) indicating that missingness was completely at random (MCAR). Therefore, missingness was handled using Full Information Maximum likelihood (FIML).

Sixty-nine percent of the parents shared a household together and in case both parents participated with multiple offspring, the interaction with the same offspring was included in the analyses. To correct for family dependency, robust standard errors were calculated using the package *lavaan.survey.fiml*. This package applies the same method as *lavaan.survey* (Oberski, 2014) but in addition allows for models with missing data estimated using FIML. In *lavaan.survey.fiml* the structural model parameter estimates are aggregated, i.e., parameter estimates are aggregated over clusters and no explicit modelling of the effects of clusters is involved. See Muthen & Satorrah (1995) for details on this procedure.

The covariance matrix was used to estimate the fit of the models. The Maximum Likelihood (ML) estimator was used to estimate the model parameters (Rosseel, 2012). The chi-square statistic is reported, but assessment of fit was based on the comparative fit index (CFI) and the root mean square error of approximation (RMSEA), since the chi-square statistic is very sensitive to sample size. Acceptable and excellent model fit is indicated by CFI values greater than .90 and .95, respectively, and by RMSEA values smaller than .08 and .06, respectively (Hu & Bentler, 1999).

Results

Preliminary analyses

Descriptive statistics and correlations of experiences of childhood maltreatment, parental interactive behavior, autonomic (re)activity and demographics are included in Table 4.1. Age was significantly negatively correlated with emotional support, negativity, RSA (baseline and reactivity), and significantly positively correlated with PEP during baseline. In addition, SES correlated positively with warmth, emotional support and baseline RSA. As expected, warmth, negativity and emotional support were intercorrelated, but correlations were lower than $r = .55$, meaning that these represent clearly distinctive parental behaviors. Likewise, abuse and neglect were correlated, though moderately ($r = .53$), meaning that they often co-occur yet represent partially distinct types of maltreatment.

Table 4.1. Mean (SD) and Pearson correlations between study variables

	M (SD)	1	2	3	4	5	6	7	8	9	10	11
1. Age	52.70 (13.19)	-										
2. Gender (% female)	57	.03	-									
3. SES	-0.02 (0.81)	-.25***	-.12	-								
4. Warmth	5.37 (1.85)	-.12	.07	-.15*	-							
5. Negativity	0.28 (0.27)	-.18*	-.01	-.09	-.55***	-						
6. Emotional support	3.20 (1.91)	-.17*	.08	.16*	-.54***	-.30***	-					
7. RSA baseline	1.60 (0.30)	-.52***	-.06	-.24**	.09	.12	.06	-				
8. PEP baseline	119.58 (26.21)	.18*	-.00	-.07	.02	-.07	.02	-.06	-			
9. RSA reactivity	0.00 (1.00)	-.15*	.23**	-.08	.02	.18*	.01	.00	.06	-		
10. PEP reactivity	0.00 (1.00)	-.03	-.09	-.04	.14	-.05	.08	.10	.01	-.01	-	
11. Exp abuse	2.04 (1.31)	.03	-.02	-.01	-.14*	.19**	-.10	-.01	.02	-.06	-.21**	-
12. Exp neglect	2.88 (1.48)	.12	.11	-.04	-.05	.05	-.04	-.23**	.05	-.18*	-.26**	.53***

Note. Exp = experienced, Gender: 0 = male, 1 = female. Values for RSA, negativity, experienced abuse and experienced neglect were log-transformed. RSA and PEP reactivity scores represent residualized change scores. * $p < .05$, ** $p < .01$, *** $p < .001$.

Experienced abuse correlated negatively with warmth and positively with negativity. Furthermore, experienced neglect correlated negatively with RSA reactivity, meaning that parents who experienced higher levels of neglect showed greater PNS reactivity in the form of PNS withdrawal during the task. In addition, there was a significant negative correlation between experienced abuse and neglect and PEP reactivity, meaning that parents with higher levels of maltreatment experiences exhibited a shorter PEP during the task indicative of greater SNS reactivity. Finally, experienced neglect correlated negatively with baseline RSA, meaning that parents who experienced higher levels of neglect had a lower baseline heart rate variability. Since RSA during baseline was not associated with experienced abuse or with parental behavior, and no associations were found between PEP during baseline and the other study variables, we decided not to test a structural model of childhood maltreatment, parental interactive behavior and baseline autonomic activity.

Structural model

As shown in Figure 4.1, the hypothesized structural model of child maltreatment experiences, parental behavior and autonomic reactivity exhibited an excellent fit: $\chi^2(12) = 12.52, p = .405$; CFI = 0.998; RMSEA = 0.014. This indicated that our hypothesized model adequately described the data. The individual pathways are described below.

Experienced neglect

Age ($\beta = -0.18, SE = 0.01, p = .005$), SES ($\beta = -0.17, SE = 0.09, p = .018$), and respiration rate ($\beta = -0.30, SE = 0.06, p < .001$) were significantly negatively associated with RSA reactivity, indicating that older parents, parents with a higher SES and parents with a higher respiration rate showed greater PNS reactivity (i.e., PNS withdrawal) during interacting with their offspring. In addition, gender was significantly associated with RSA reactivity ($\beta = 0.24, SE = 0.15, p = .002$), such that mothers showed a greater degree of PNS withdrawal while interacting with their offspring. Smoking, but not physical exercise, was significantly negatively associated with RSA reactivity ($\beta = -0.22, SE = 0.14, p < .001$), and therefore included as an additional covariate in the regression equation for RSA.

Taking demographic variables and smoking into account, experienced neglect showed, as expected, a significant negative association with RSA reactivity ($\beta = -0.19, SE = 0.05, p = .005$). This indicates that parents who experienced higher levels of neglect during their childhood showed more PNS withdrawal during the interaction task with their own offspring. Furthermore, in accordance with our expectations, experienced neglect was significantly negatively associated with PEP reactivity ($\beta = -0.21, SE = 0.06, p = .022$), indicating that parents who experienced more childhood neglect exhibited stronger SNS reactivity during the task. Age, gender and SES ($ps > .295$) were taken into account for PEP reactivity to control for demographic characteristics. Smoking and physical exercise were not significantly associated with PEP reactivity during the task ($ps > .154$).

Goodness of fit statistics

$\chi^2 = 12.52$ ($p = .405$, $df = 12$)
RMSEA = 0.014
CFI = 0.998

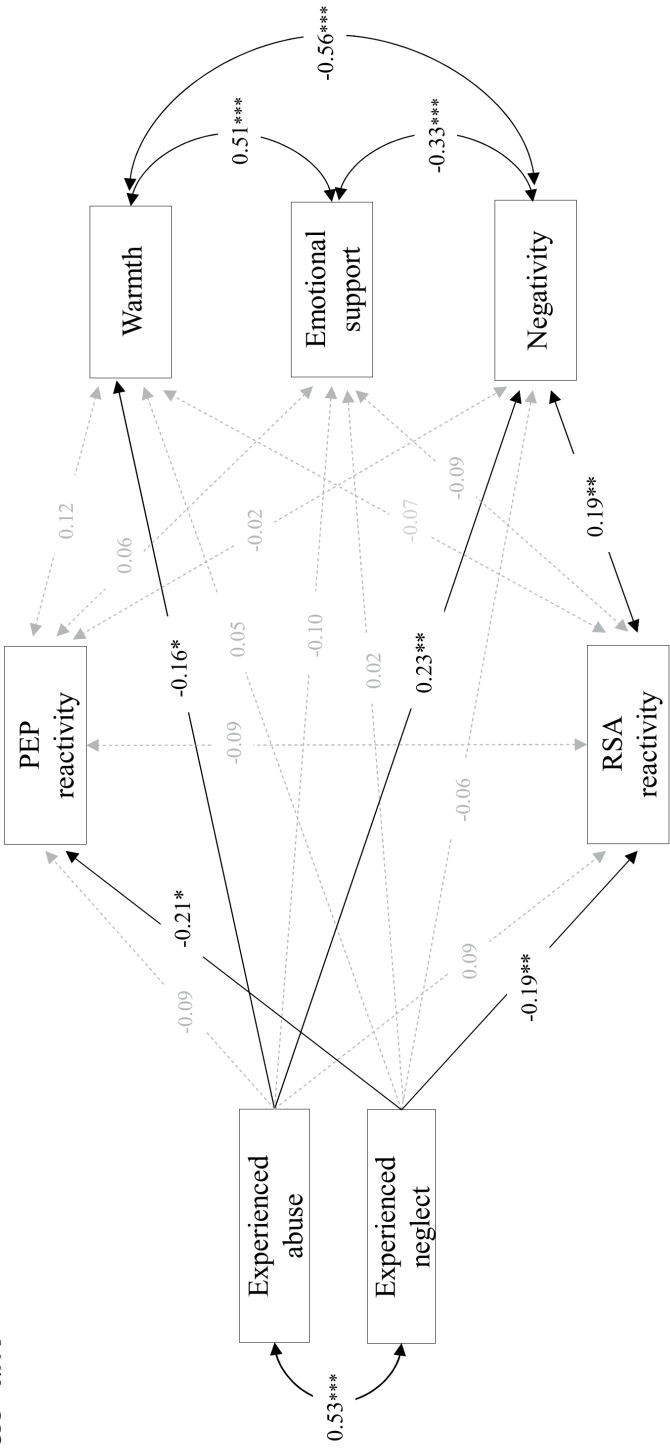


Figure 4.1

Structural model of childhood maltreatment experiences, parental interactive behavior and autonomic reactivity during parent-offspring interactions RSA reactivity and PEP reactivity represent residualized change scores. Lower residualized change scores for RSA and PEP reflect greater PNS withdrawal and SNS activation from baseline to task, respectively. Standard errors are corrected for the dependency in the data. The nuclear family was used as the cluster unit for the correction. Path coefficients are standardized regression weights. Dotted lines indicate nonsignificant paths. Covariates (ages, gender, SES, supportive role, respiration rate, smoking) are not displayed.

* $p < .05$; ** $p < .01$; *** $p < .001$

and consequently were not included as additional covariates in the model. Incongruent with our expectations, experienced neglect was not significantly associated with any type of parental behavior (i.e., warmth, negativity and emotional support), indicating that a history of childhood neglect was associated with physiological responses, but not with behavioral responses as assessed in the current study.

Experienced abuse

A history of childhood abuse was, as expected, negatively associated with warmth ($\beta = -0.16, SE = 0.12, p = .046$), and positively associated with negativity ($\beta = 0.23, SE = 0.02, p = .005$), indicating that parents who experienced more abuse during their childhood showed less warmth and more negativity towards their offspring. Contrary to our hypothesis, no significant relation was found between parents' childhood abuse experiences and parents' emotional support towards their offspring ($\beta = -0.10, SE = 0.11, p = .133$). In addition, a history of abuse was not significantly associated with RSA reactivity ($\beta = 0.09, SE = 0.05, p = .199$) or PEP reactivity ($\beta = -0.09, SE = 0.07, p = .367$). Thus, a history of abuse was associated with parents' behavioral responses, but not with their autonomic reactivity.

Autonomic reactivity and parental interactive behavior

Our expectation that RSA reactivity would be associated with negativity was in part confirmed, although the direction of the association was opposite to our hypothesis. RSA reactivity was positively associated with negativity ($\beta = 0.19, SE = 0.02, p = .009$), indicating that parents who were more negative towards their offspring showed blunted PNS reactivity. Contrary to our hypotheses, no significant associations were found between RSA reactivity and warmth, $\beta = -0.07, SE = 0.12, p = .388$, or emotional support, $\beta = -0.09, SE = 0.12, p = .203$. Finally, no significant associations were found between PEP reactivity and any type of parental interactive behavior ($ps > .102$), indicating that parental warmth, negativity and emotional support did not associate with SNS reactivity.

Exploratory analysis: mediation of rsa reactivity

The structural model (Figure 4.1) showed that experienced neglect was negatively associated with RSA reactivity, which in turn was positively associated with negative behavior. Hence, we explored whether RSA reactivity mediated the association between experienced neglect and negativity. The indirect effect was tested using a bootstrap estimation approach with 1000 samples. The results indicated that the indirect effect was not significant, $\beta = -0.01, SE = .003, 95\% CI = -0.112, 0.102$, indicating no mediation of RSA reactivity in the association between experienced neglect and negativity.

Sensitivity analyses

Results did not alter when the 13% participants who participated both as parent and as offspring in the interaction task were randomly included as either parent or offspring.

Furthermore, correlations between baseline and activity scores were high for PEP ($r = .94$) and for RSA ($r = .88$). To examine the robustness of the results on autonomic reactivity we therefore conducted sensitivity analyses in which autonomic reactivity scores (residualized change scores) in the structural model were replaced with raw autonomic activity scores during the interaction task. Associations between experienced neglect and RSA activity ($\beta = -0.22$, $SE = 0.01$, $p < .001$) and between RSA activity and negativity ($\beta = 0.15$, $SE = 0.00$, $p = .019$) remained significant. However, the association between experienced neglect and PEP activity ($\beta = -0.08$, $SE = 1.43$, $p = .348$) was not significant anymore.

Discussion

The current study is the first to investigate the role of childhood abuse and neglect in parents' autonomic *and* behavioral responses during a parent-offspring conflict interaction task. Our findings showed that experiences of childhood neglect were uniquely associated with autonomic *hyper*-reactivity responses, whereas experiences of childhood abuse were uniquely associated with behavioral responses while discussing conflict. Thus, there may be unique consequences of the two types of childhood maltreatment, above and beyond effects they might have in common. Moreover, behavioral responses were positively associated with RSA reactivity, such that parents who showed more negative behavior towards their offspring exhibited blunted PNS reactivity during the conflict interaction task.

Differential consequences of abuse and neglect

Parents who experienced higher levels of neglect during their childhood showed greater RSA reactivity in the form of RSA reduction (i.e., PNS withdrawal) and greater PEP reactivity in the form of PEP shortening (i.e., SNS activity) while discussing conflict with their offspring, indicative of autonomic *hyper*-arousal. This was in line with our expectations. We also found that childhood neglect was associated with lower basal RSA, indicating chronic cardiovascular *hyper*-arousal (Brosschot et al., 2005). Given high correlations between baseline and activity assessments (with potential negative implications for residualized change scores), we conducted sensitivity analyses with the raw activity scores (i.e., activity scores during the conflict interaction task uncontrolled for baseline). These analyses showed similar results for RSA reactivity and activity, but not for PEP reactivity and activity. Associations between experienced neglect and RSA thus seem more robust than estimates for PEP. Unexpectedly, no associations were observed between parents' experiences of

childhood neglect and their expressions of warmth, negativity and emotional support towards their offspring.

Results regarding abuse differed from those of neglect. As expected, and in line with previous research (Vaillancourt et al., 2017), we found that parents who experienced more abuse during their childhood showed less warmth and more negativity while discussing conflict with their offspring. Unexpectedly, experiences of childhood abuse were not significantly associated with RSA or PEP reactivity, indicating that a history of abuse only associated with behavioral responses, but not with autonomic responses.

The present findings suggest that abuse and neglect may differentially affect physiological and behavioral systems. Neglect, which is characterized by unresponsive parenting, may more strongly affect physiological stress responses, whereas abuse, which is characterized by physical or verbal aggressive parenting, may more strongly impact behavioral responses. Child neglect is more likely to reoccur and more intractable to intervention than other forms of child maltreatment – as measured by the percentage of recurrences of child maltreatment following a report to Child Protective Services (Jonson-Reid, Drake, Chung, & Way, 2003; Lipien & Fortthofer, 2004), reduced reunification rates of children in care (i.e., Biehal, Sinclair, & Wade, 2015) and effectiveness of home visitation on recurrences of child maltreatment (i.e., MacMillan et al., 2005). Moreover, neglect can be hard to identify for professionals and therefore may often go unnoticed (Jones & Gupta, 1998). Consequently, child neglect is frequently thought of as a chronic pervasive problem that is difficult to resolve (Hildyard & Wolfe, 2002; Jones & Gupta, 1998). (Hildyard & Wolfe, 2002). As such, neglect is considered a pervasive chronic stressor, which might fail to buffer individuals from stressors and chronic activation of the ANS system (De Bellis, 2005). When the stress system is exposed to chronic stress, such as neglect, physiological responses may become dysregulated, i.e. allostatic load (Danese & McEwen, 2012). Indeed, foster children and adopted post-institutionalized children, who have typically experienced chronic neglect, were found to exhibit elevated ANS reactivity to stressors (Gunnar, Frenn, Wewerka, & Ryzin, 2009; Oosterman et al., 2010). Furthermore, in one of our previous studies we found that childhood neglect, but not childhood abuse, was associated with elevated ANS activity of parents in a pseudo parenting context (Buisman et al., 2018). Results of the present study, however, are inconsistent with one other study in which abuse (physical and sexual) was found to be associated with elevated ANS reactivity (Heim et al., 2000). Yet, the researchers did not statistically control for neglect, making it unclear to what extent neglect may have accounted for this association. Moreover, although neglect frequently involves ongoing situations (i.e., Lipien & Fortthofer, 2004; Hildyard & Wolfe, 2002), it is not unlikely for abuse to also follow a chronic pattern. To date, there have been no other studies that explicitly compared the effects of abuse and neglect on ANS reactivity and regulation. Additional research, that also takes maltreatment chronicity into account, is needed to confirm and understand differential consequences of abuse and neglect on

ANS functioning of parents, specifically while they are interacting with their offspring.

Childhood abuse, contrary to childhood neglect, may more strongly affect the behavioral system through learning of maladaptive behavioral patterns. Social learning theory (Bandura, 1973) postulates that childhood abuse may result in interpersonal aggression, as children generalize from their experiences with abusers and assume aggression – which can be verbal or physical – to be a suitable and effective form of interpersonal behavior. Such an aggressive interpersonal style may be applied to social interactions in general, or may indicate a specific set of parenting behaviors or beliefs that is transmitted from generation to generation. In accordance with this theory, research has consistently found that harsh and abusive parenting is uniquely associated (i.e., controlled for neglect) with more aggression in the offspring (e.g., Cohen, Brown, & Smaile, 2001; Litrownik et al., 2005). Likewise, in the parent-offspring context, research has shown that parents with a childhood history of abuse demonstrate more hostility (e.g., expressed impatience, frustration) towards their children (Pasalich, Cyr, Zheng, McMahon, & Spieker, 2016; Vaillancourt et al., 2017). Again, it should be noted that most studies that observed parenting behavior did not statistically control for other types of maltreatment, leaving open the possibility that co-occurring experiences of neglect accounted for these associations.

The present findings may also indicate that parents with childhood experiences of abuse or neglect are more likely to engage in that same type of maltreating behavior towards their own offspring: i.e., neglected parents might be more likely to neglect – but not to abuse – their offspring, and vice versa. Our findings demonstrated that parents with more childhood abuse experiences showed less warm and more negative behavior towards their offspring. This has been more often observed in abusive parents (Borrego, Timmer, Urquiza, & Follette, 2004; Bousha & Twentyman, 1984; Herrenkohl, Toedter, & Yanushefski, 1984). Neglectful parents, on the other hand, are typically characterized by a lack of involvement (Bousha & Twentyman, 1984), which may be unobservable during a task were they are ‘forced’ to interact with their offspring. Instead, these parents may experience more stress as a consequence, which may – in part – explain their enhanced ANS response.

Associations between behavioral and autonomic reactivity

We also found that parents who exhibited blunted PNS reactivity showed more negativity while discussing conflict with their offspring. This was unexpected, because greater PNS reactivity (i.e., PNS withdrawal) is thought to accompany negative emotional states (Beauchaine, 2001). Likewise, in the parent-offspring context, it has been shown that PNS withdrawal is associated with more negative interactions, i.e., harsh discipline techniques (Lorber & O’Leary, 2005). However, PNS withdrawal has also been associated with less negative behavior (i.e., intrusive behavior) in mothers participating in a stressful parent-offspring paradigm, but only among mothers with high cortisol levels (Mills-Koonce et al.,

2005). The authors speculated that vagal withdrawal during a parenting challenge may protect mothers from demonstrating negative parenting behavior when they experience either chronic or acute stress. Since we only used ANS activity as an index of physiological reactivity and did not measure cortisol, we cannot test this hypothesis. Replication of our findings including measures of multiple physiological systems are needed to further disentangle associations between these biological systems and complex parenting behaviors.

Limitations and recommendations for future studies

Several methodological issues of our study deserve attention. First, we acknowledge the potential limitations of using a self-report methodology to investigate child maltreatment. Participants may have difficulty recalling childhood events (Edwards et al., 2001) or may be reluctant to disclose certain experiences or behaviors. Nonetheless, official records may seriously underestimate the prevalence of child maltreatment (e.g., Swahn et al., 2006). Future research should consider using multiple data sources to estimate child maltreatment.

Second, the retrospective assessment of maltreatment precludes conclusions about causality. However, apart from intervention studies with a prospective design, it is ethically impossible to conduct true experiments to examine the consequences of child maltreatment.

Third, our study included parents and offspring with a large age range, while the effects of maltreatment on parent-offspring interactions may differ across different stages of child development. Limited power prevented investigating age differences reliably. Although the large age range increases the generalizability of our findings to parent-offspring relationships across the lifespan, studies with more power to test group differences or studies with a prospective design may provide insights into the differential impact of childhood maltreatment experiences on parent-offspring interactions across the life-span. Because conflict with parents is thought to increase during adolescence (e.g., McGue et al., 2005) and to decrease during adulthood (e.g., Buhl, 2007), future studies may examine whether parents' history of childhood maltreatment has a more pronounced effect on parent-adolescent interactions compared to parent-child and parent-adult interactions.

Fourth, the present study focused on parental physiological and behavioral responses. However, parent-offspring interactions are not only influenced by parental behavior but reflect a dyadic process, assuming bidirectionality in parent-offspring interactions (Kuczynski, 2003). A direction for future research may be to examine if, for instance, moment-to-moment synchrony in the interaction moderates the associations found in the current study.

Furthermore, observations are considered to carry higher ecological validity than questionnaires in examining parenting behavior. Nonetheless, observations for the present study were done in a laboratory setting, which may have affected parents' behavior due

to social desirable responding. Future studies should consider using longer observation periods and home observations, which may elicit typical parenting behavior – including the absence of interactions – to a greater extent.

Moreover, structural equation modeling is considered a strong data-analytic technique, and post hoc modifications to establish good model fit were not necessary. Nevertheless, our results may be subject to sampling effects and require replication in different populations and different settings, especially since our sample consisted mainly of Caucasian parents.

Finally, we found no evidence for ANS reactivity as a mediator of the association between childhood maltreatment experiences and parenting. However, ANS reactivity and parenting were measured concurrently. Future studies with a longitudinal design should investigate this mediating process further.

Conclusion

In sum, the present study suggests that behavioral and physiological systems respond differentially to childhood abuse and neglect. While discussing conflict with their offspring, parents who experienced higher levels of childhood abuse responded more strongly on a behavioral level but not on an autonomic level, whereas the opposite pattern was observed for parents who experienced more childhood neglect. Both response patterns, however, may indicate maladaptive emotion regulation and responding that, in turn, may contribute to the transmission of dysfunctional caregiving (Jaffee, 2017). These results support previous suggestions that individuals with maltreatment experiences may benefit from interventions aimed at physiological and behavioral-based stress regulation (e.g., Maughan & Cicchetti, 2002). Moreover, although different types of maltreatment often co-occur (Herrenkohl & Herrenkohl, 2009), findings of the present study suggest that they do represent different experiences, highlighting the need to measure different types of maltreatment and to compare their separate influences. This will promote effective targeting of intervention and preventive efforts and understanding of the developmental pathways from unique experiences to adaptive parenthood.

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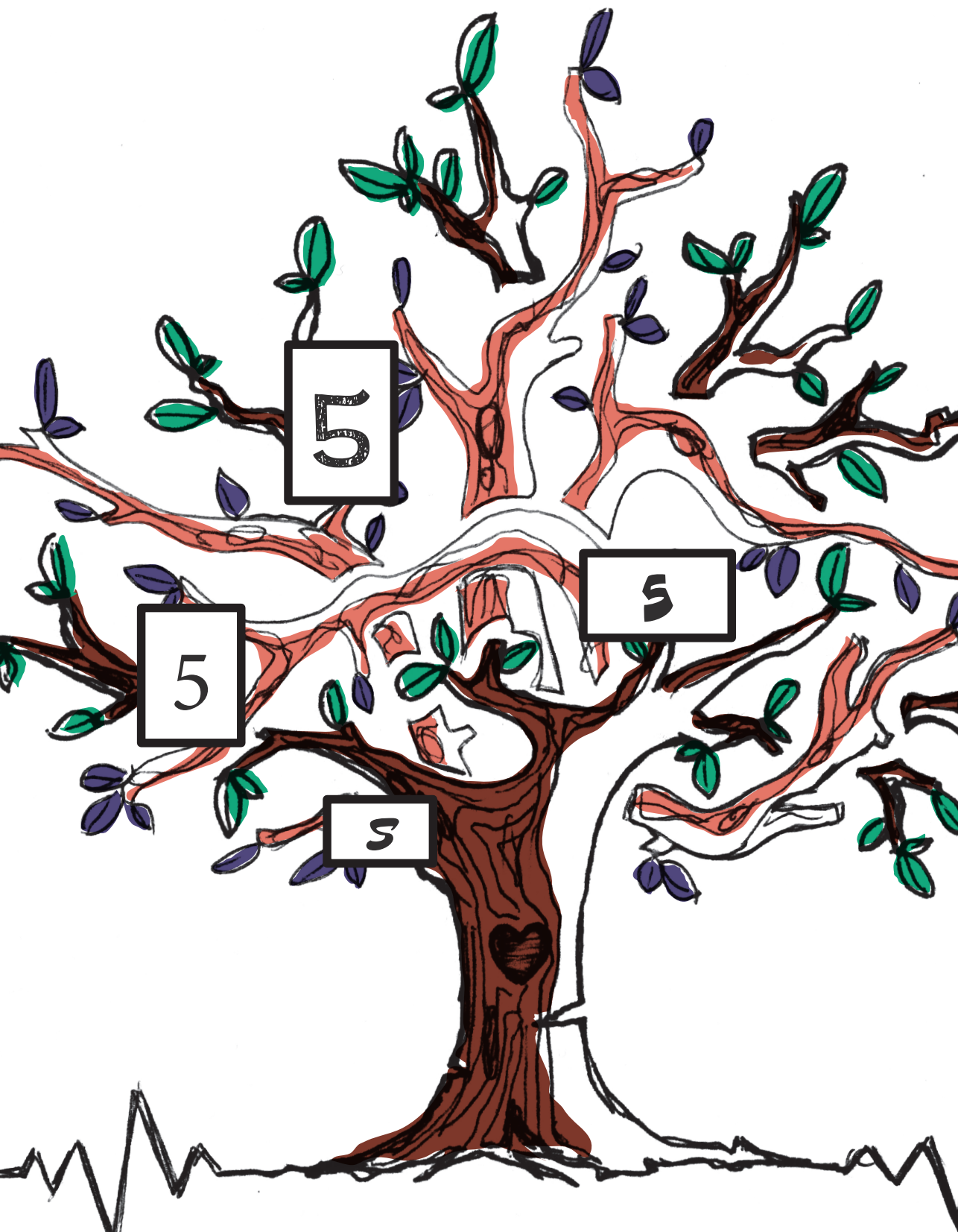
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5

Chapter 5

Child maltreatment and parent-offspring interaction: A multigenerational extended family design

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Abstract

In the current study we examined the associations between multiple types of maltreatment (abuse and neglect), parent-offspring interactions and family cohesion in an extended family study. A total of 366 parent-offspring pairs from 137 nuclear families participated. Parents ($M_{\text{age}} = 52.8$ years, age range: 26.6–88.4 years, 57% female) reported about perpetrated child maltreatment and offspring ($M_{\text{age}} = 25.7$ years, range: 7.5–65.5 years, 58% female) about experienced maltreatment during their childhood. Parent-offspring interactions were observed during a conflict interaction task. Cohesion within the nuclear family was observed during a playful tower building task. Results showed that parents and offspring displayed more aversive behavior in parent-offspring dyads characterized by higher levels of child abuse, but not in dyads characterized by higher levels of child neglect. In addition, more dyadic affective dissimilarity was observed in parent-offspring dyads characterized by higher levels of childhood neglect, whereas dyadic affective dissimilarity was lower in dyads characterized by higher levels of childhood abuse. Findings imply that interventions focused on parent-offspring interactions with a somewhat different content for neglectful and abusive families, may be efficacious for families in the child welfare system.

Keywords: child maltreatment, parent-offspring interactions, conflict interaction task, family cohesion

Introduction

Both social learning theory (Bandura, 1973) and attachment theory (Bowlby, 1969) assume that interaction patterns learned and enacted during childhood and adolescence provide the foundation for relationships later in life. High quality parent-child interactions incorporate mutual warmth and affection, parental contingent responsiveness, and sensitivity to children's state and interests (e.g., Ainsworth et al., 1978). An extensive body of research has provided evidence that the quality of parent-child interactions is essential for children's social emotional as well as cognitive development (e.g., Eisenberg et al., 2001; Tamis-LeMonda, Bornstein, & Baumwell, 2001). However, these interaction patterns seem to be disrupted in maltreating families (e.g., Madigan et al., 2006; Wilson, Rack, Shi, & Norris, 2008). A common approach to the treatment of maltreating families, therefore, is parent-child interaction therapy (Batzer, Berg, Godinet, & Stotzer, 2018). Yet, research on the association between parent-offspring interactions and maltreatment types other than abuse (i.e., neglect) is scarce and no studies have investigated the link between child maltreatment and parent-offspring interactions with adult offspring. In addition, few observational studies have investigated father-offspring interactions or examined parent-offspring interactions in the context of the nuclear family. The current study addresses these gaps in the literature.

Observational methods provide important data about parenting since convergence between self-reported and observed parental behavior is typically low, particularly in mothers from high-social-risk populations, likely due to socially desirable responding (Bennett, Sullivan, & Lewis, 2006; Fitzgerald, Shipman, Jackson, McMahon, & Hanley, 2005). However, observational studies are labor intensive, often resulting in small sample sizes, which may in part explain mixed findings. A meta-analysis of 30 observational studies comparing maltreating and non-maltreating parents in terms of their aversiveness, positivity, and involvement during interactions with their children, found medium effect sizes for all three types of behavior (Wilson et al., 2008). Moreover, physically abusive parents could be distinguished from non-maltreating parents more so than neglectful parents in terms of aversive behavior, whereas involvement better distinguished neglectful from non-maltreating parents. Notably, only a handful of studies included neglectful parents or fathers and there were no studies with emotional abusive parents, thus limiting conclusions about these groups. Few observational studies on maltreatment and parent-child interactions have been published after this 2008 meta-analysis (but see, e.g., Skowron et al., 2011). Moreover, to our knowledge, no studies have examined the association between maltreatment and parent-offspring interactions with adult offspring, even though the parent-offspring relationship constitutes one of the most long-lasting social relationships and continues to be of importance in the lives of most adults (Van Wel, Linssen, & Abma, 2000).

Several observational studies on parent-offspring interactions have investigated the behavior of the offspring in relation to child maltreatment. Some studies show that offspring in maltreating families displayed different behavior compared to offspring in non-maltreating families. For example, Cerezo & D'Ocon (1999) reported that during parent-child interactions abused children exhibit aversive behaviors more frequently than non-abused children. A longitudinal study of mother-child interactions found that toddlers who were abused by their mother during infancy engaged in less child-initiated play, indicative of less socially competent behavior, than did toddlers from neglecting and non-maltreating mothers (Valentino, Cicchetti, Toth, & Rogosch, 2011). Nevertheless, other observational studies on parent-child interactions suggest that observed child behaviors do not reliably differentiate maltreated children from non-maltreated children. For example, Lau and colleagues (2006) showed that even though parents in the abuse group displayed more emotionally controlling and less supportive behavior during an interaction task, there was no association between abuse history and observed child behaviors during interactions with their parents.

In situations where the victim and the perpetrator have an ongoing relationship – as is the case when a parent maltreats their child – relationship dynamics can play an important role (Urquiza & Timmer, 2002). Yet, we know little about the association between maltreatment and parent-child interactions on a dyadic measurement level. In the present study we therefore explored the discrepancy between parents' and offspring's overall affective expression, hereafter referred to as dyadic affective dissimilarity. Some studies have examined the temporal organization of affective expressions in parent-child dyads. Mothers at high risk for child maltreatment were found to show more interactive affective mismatch and more mother-initiated ruptures (Skowron, Kozlowski, & Pincus, 2010). In addition, Guilliano and colleagues (2015) observed parent-child interactions during a puzzle task and found decreases in mutually positive mother-child behaviors over time in dyads with maltreating mothers. Based on these studies, we expected higher dissimilarity in parent-offspring dyads of whom the parents perpetrated higher levels of maltreatment.

Parent-offspring interactions occur within the context of the family. However, to date, the majority of the observational studies on parent-offspring interactions and maltreatment investigated parent-child interactions with only one parent (mostly the mother) and one child. Dependent on the method used to assess parental behavior, less than 50% of the variance in parental negativity and positivity is the same across siblings in studies using parental reports and this is reduced to approximately 25% in observational studies (Browne et al., 2012; Jenkins et al., 2003). Moreover, research has shown that similarity in parenting behavior is higher for monozygotic twins than for dizygotic twins or full siblings (Avinun & Knafo, 2014; Bakermans-Kranenburg et al., 2019) indicating that genetic characteristics of children may elicit certain types of parenting behavior. Although research on the degree of

correspondence between maternal and paternal parenting behavior is somewhat limited, there is evidence suggesting only modest similarity in parenting styles of two parents within the same home (Winsler, Madigan, & Aquilino, 2005). A family design offers opportunities to study how much of the variance in parents' interaction style is the same across siblings and whether father and mother interact with their children in the same manner.

In addition, families can be understood as entities and as greater than the sum of parts (Bowen, 1971). According to Bowen's family systems theory the family should be viewed as an emotional unit. Although treatment at the family level has been advocated for several years in the field of child maltreatment (e.g., Cicchetti & Toth, 1995), few observational studies have investigated maltreating families as a unit. Research examining family interactions has shown that abusive and neglectful families are less organized and less effective in working together toward the achievement of common goals compared to non-maltreating families (Gaudin, Polansky, Kilpatrick, & Shilton, 1996; Howes, Cicchetti, Toth, & Rogosch, 2000). In the present investigation, therefore, we also observed family cohesion as a proxy for family interactions at the system level.

The current study

In order to gain further insight into the link between maltreatment and family interactions, the present study examined the associations of two types of childhood maltreatment (abuse and neglect) with dyadic parent-offspring interactions during a conflict interaction task and family cohesion during a playful tower building task in an extended family design. We examined maternal *and* paternal interactions with multiple offspring spanning a wide age range. Multilevel modeling was used to account for the hierarchical structure of the data and to examine the amount of variance in dyad interactions that is the same across siblings and across parents. Based on previous literature (Browne et al., 2012; Jenkins et al., 2003; Howes et al., 2000; Wilson et al., 2008) our main hypotheses were:

1. Parents and offspring communicate more negatively towards each other in dyads with higher levels of childhood abuse and neglect.
2. Dyadic affective dissimilarity will be higher in dyads with higher levels of childhood abuse and neglect, but no assumptions were made regarding whether parents or offspring would be more negative due to a lack of comparable research.
3. There is similarity in parenting behavior across siblings and modest similarity in parenting behavior displayed by two parents of the same offspring.
4. Family cohesion is lower in families characterized by higher levels of childhood abuse and neglect.

In addition, we explored whether abuse and neglect were differentially associated with parent-offspring interactions. Finally, we explored whether the association between maltreatment and dyadic parent-offspring interactions is moderated by age and gender of the parents, since the majority of observational studies included mother-child

interactions but not father-child interactions and studies on parent-offspring interactions with adult offspring are lacking.

Method

Sample

Participants of the current study were part of the larger 3G Parenting Study, a family study on the intergenerational transmission of parenting styles, stress and emotion regulation. (See also Buisman et al., 2018; Buisman et al., 2019). A total of 395 participants from 63 families with two to four generations and an average of 6.27 family members per family (range: 2 to 23) agreed to participate. All participating parent-offspring dyads were included in the current study. See Buisman et al. (2018) and van den Berg et al. (2018) for a description of the recruitment and procedure.

Nuclear families

Within the 63 extended families, there were 137 nuclear families consisting of 366 parent-offspring dyads. Forty-eight nuclear families participated with two parents and two offspring, 30 families consisted of one parent and one offspring, 28 families consisted of two parents and one offspring, 22 families consisted of one parent and two offspring, six families consisted of two parents and three offspring, two families consisted of one parent and three offspring, and one family consisted of one parent and seven offspring. This resulted in 387 participants among whom 57 (15%) participated both as parent and as offspring.

Parents

Data were available for 219 parents (94 males, 125 females). The average age was 52.8 years ($SD = 13.3$, age range: 26.6–88.4 years). The vast majority of parents were Caucasian (94%), 1% were of Antillean descent, 1% were of Latin-American descent, and 1% were of mixed descent. Ethnicity was unknown for 3% of the participants. Eight percent of parents had completed elementary school, 62% had an advanced secondary school or vocational school diploma, and 27% held a college or university degree. The educational level of 3% of parents was unknown.

Offspring

Data for 225 offspring (95 males, 130 females) were included. The average age was 25.7 years ($SD = 14.1$, age range: 7.5–65.5 years). The vast majority of the children (91%) were Caucasian, 4% were of Antillean descent, 1% were of Latin-American descent, and 1% were of mixed descent. Ethnicity was unknown for 3% of the participants. Fifty percent of the

offspring were still in primary or high school, 30% had an advanced secondary school or vocational school diploma, and 20% held a college or university degree.

Measures

Dyadic parent-offspring interactions

Patterns of interaction between parents and offspring were observed during a parent-offspring conflict interaction task, also known as revealed differences task (Strodtbeck, 1951). Dyads consisting of one parent and one offspring were asked to discuss an issue on which they disagreed and try to reach consensus within ten minutes in a separate room. The interactions were filmed and no other people were in the room.

Interactions were coded with The Supportive Behavior Task Coding Manual, Version 1.1 (Allen et al., 2001). Parents and offspring received scores for *Warmth*, *Negativity* and *Emotional support*. In addition, we coded the *Discussion of a problem* and *Supportive role* (i.e., the extent to which a person was expected to be supportive during the conversation).

The dyadic parent-offspring interaction task was coded independently from the playful tower building game. Interactions were coded by the first author and three trained research assistants. Members of the dyads were coded independently. Coders were blind to maltreatment history and maltreatment perpetration of the individual they coded, as well as to the scores of the individual in interaction with other family members. Interrater reliability between all pairs of observers was adequate to good, with intraclass correlations for the separate pairs (ICCs; single measures, absolute agreement) ranging from .71 to .82 for *Warmth*, .66 to .78 for *Negativity* and .72 to .80 for *Emotional support*. Cohen's Kappa showed perfect interrater reliability ($k = 1.0$) for *Discussion of a problem* and good interrater reliability ($k_{\text{range}} = .70 - .80$) for *Supportive role*.

Based on these ratings, three new variables were constructed: 1) *Parent-to-offspring communication*, 2) *Offspring-to-parent communication*, and 3) *Dyadic affective dissimilarity*. A principal component analysis (PCA) on warmth, negativity and emotional support from parents towards offspring pointed to one underlying component, explaining 62% of the variance. Component loadings for *Warmth*, *Negativity* and *Emotional support* were .87, .76 and .72, respectively. Therefore, the ratings were aggregated to an average communication score from parents toward offspring. Higher scores indicate a more positive communication style from parents towards offspring. As expected, most offspring (68%) did not provide any emotional support towards their parents. As a result, the distribution of emotional support from offspring had a high kurtosis and was highly skewed. In addition, especially when it comes to underage offspring, emotional support from offspring may have a different meaning (e.g., role reversal) than emotional support from parents. We therefore decided to only aggregate the scores of *Warmth* and *Negativity* to yield an average score for *Offspring-to parent-communication*. Higher scores indicate a more positive communication from

offspring towards parents. Cronbach's alpha was good ($\alpha = .70$). Finally, a *dyadic affective dissimilarity* score was formed by subtracting communication of parents towards children from communication of children towards parents. For this variable, *Parent-to-offspring communication* was based on *Warmth* and *Negativity* only – as was the case for *Offspring-to-parent communication* – such that the scores of parents and offspring are comparable (parent to offspring communication and offspring to parent communication correlated positively, $r = .66$, $p < .001$). Positive values on *dyadic affective dissimilarity* indicate that parents communicate more positively than offspring, whereas negative values indicate that parents communicate more negatively than offspring. Dyadic parent-offspring interactions were missing for 22 dyads due to technical problems and for 10 dyads because parents and offspring could not attend at the same day. See Buisman et al. (2019) for a detailed description of the task and the coding of the constructs.

Family cohesion

Family cohesion was observed during a playful tower building game (Jenga). Nuclear families were asked to collaborate in building a tower as high as possible with the provided wooden parts. They were instructed to work on it for 10 minutes, and to start over should the tower collapse. The tower building was filmed and no other people were in the room. Family cohesion was coded with the System for Coding Interactions and Family Functioning (SCIFF; Lindahl, & Malik, 2000).

The tower building task was coded by the first author and a trained research assistant (who did not code the dyadic parent-offspring interactions, see below). Coders were blind to maltreatment history and maltreatment perpetration. Interrater reliability (ICC; single measures, absolute agreement) between the two observers was .73, indicating good reliability. Observations of family cohesion were missing for 12 nuclear families due to technical problems and for 6 families because parents and offspring could not attend on the same day. For more details on the task and the coding of the constructs see Supplementary material Chapter 5.

Child maltreatment

Child maltreatment was measured using a combination of the Parent-Child Conflict Tactics Scales (CTS-PC; Straus, Hamby, Finkelhor, Moore, & Runyan, 1998) and the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994; Thombs, Bernstein, Lobbestael, & Arntz, 2009).

Offspring completed a version that assessed the extent to which they had experienced specific physically or psychologically neglectful or abusive behaviors from their father and/or mother before the age of 18 years. Parents reported the extent to which they had conducted these behaviors towards each of their offspring. For offspring under 12 years of age, the questionnaire about experienced maltreatment was administered orally and questions about very severe physical abuse were omitted. Offspring aged 12-18 years and living with their parents at the time of the study indicated whether they had experienced

maltreatment within the last year or in the years before. Per item, the higher score of these two was included in all calculations. For offspring aged 18 years or older, lifetime maltreatment (until 18 years) was assessed. See Buisman et al. (2019) for a detailed description of the scales, including its internal consistencies.

For each parent-offspring dyad one *neglect* and one *abuse* score was created, indicating the child maltreatment that had occurred within this particular dyad. *Abuse* scores were calculated by averaging offspring's self-reported experienced abuse from mother or father (offspring report) and parents' self-reported perpetrated abuse towards that particular offspring (parent report). *Neglect* scores were calculated in the same manner. Parent reported child maltreatment correlated significantly with offspring reported child maltreatment: $r = .25$; $p < .001$ for neglect and $r = .37$; $p < .001$ for abuse.

Because the distribution of the CTS data was skewed to the right, scores were log-transformed and then multiplied by 10 to scale up the variance. There were two outliers, which were winsorized, i.e., the difference between the two next highest values was added to the next highest value with standardized value < 3.29 (Tabachnik & Fidell, 2001) to fit the distribution.

Demographic information

Age, gender and socio-economic status (SES) of parents and offspring were assessed via questionnaires. SES was based on household income and highest completed education. Yearly household income was measured on a 7-point scale ranging from (1) less than € 15,000 to (7) more than € 65,000. Education was also rated on a 7-point scale. Based on standardized household income and standardized completed educational level a composite SES score was calculated.

Analyses

Multiple imputation

Missing values were imputed by means of multiple imputation (MI) with the package '*mice*' (van Buuren & Groothuis-Oudshoorn, 2011) in R (R Development Core Team, 2018). MI has the advantage of imputing each missing value multiple times, so that uncertainty of each imputation is reflected in the variance of the different estimates of the same missing value. This variance can be taken into account in the analyses (Allison, 2002). The package '*mice*' imputes incomplete multivariate data by chained equations (Van Buuren & Groothuis-Oudshoorn, 2011). The data were imputed 100 times incorporating all variables that are included in the main analyses. Three percent of all values were missing (range: 0 to 12%). Predictive mean matching (PMM; Little, 1988) was used as multiple-imputation method. Multiple imputation by PMM ensures that imputed values are plausible, because it borrows an observed value from a donor with a similar predictive mean. Autocorrelation function (ACF) plots revealed that imputations converged (Azur, Stuart, Frangakis, & Leaf, 2011). In addition, the correlations

between variables were approximately the same in the imputed datasets compared to the non-imputed dataset (see Supplementary material Table S5.1 and Table S5.2).

Dyadic parent-offspring interactions

Using the pooled data, we computed three separate linear mixed models to evaluate the associations between maltreatment and the dyadic parent-offspring interaction variables: 1) parent to offspring communication, 2) offspring to parent communication, and 3) dyadic affective dissimilarity. Crossed random effects were specified for parents and offspring, since offspring were nested within parents (parents participated with multiple offspring) and parents were nested within offspring (offspring participated with father and mother). A family level was specified for the nesting of parents and offspring within extended families. For every outcome we started with an unconditional means model (Model 1) – which decomposed the variance in the outcome measures into four independent components: the unique component of each parent, i.e., level 2 random effect σ_{up0}^2 , the unique component of each offspring, i.e., level 2 random effect σ_{uo0}^2 , the unique component of each family, i.e., level 3 random effect σ_{p0}^2 , and the residual component σ_e^2 . This model was used to compute the intraclass correlation coefficient (ICC) at the family level, the parent level, and the offspring level. Covariates (age parent, gender parents and offspring, SES parents and offspring, supportive role, discussion of a problem) were added to the unconditional means model, and omitted when p -values exceeded .05 (Model 2). In the next step abuse and neglect were simultaneously entered to evaluate whether each maltreatment type had unique associations with the outcome of interest (Model 3). Next, family cohesion was added as predictor to evaluate the association between maltreatment and dyadic parent-offspring interactions when family cohesion is held constant (Model 4). Finally, maltreatment type and the interaction of maltreatment with gender and age were added one by one to see whether it resulted in an improved model fit. In case of no significant interactions and no model fit improvement the interactions were removed from the model (indicated in the footnote of the Tables). The linear mixed models were fitted using the 'lmer' function in the lme4 package (Bates, 2005) in R (R Core Team, 2018). Model fit was compared using an F reference distribution, since the likelihood ratio is only supported for multiply imputed data in models with a single cluster variable (Li, Raghunathan, & Rubin, 1991). Continuous predictors were centered on their mean.

Family cohesion

In addition, we computed a multilevel linear model to evaluate whether the average amount of maltreatment that occurred in a nuclear family was associated with family cohesion. Two levels were specified: the nuclear family level and the extended family level. We started with an unconditional means model (Model 1) – which decomposed the variance in family cohesion into two independent components: the unique component of each extended family σ_{u0}^2 and the residual component σ_e^2 . This model was used to compute the intraclass correlation

coefficient (ICC) at the extended family level. In an initial step covariates aggregated at the nuclear family level (age parents, gender parents and offspring, SES parents and offspring, and family size of the nuclear family) were included, and omitted when p -values exceeded .05 (Model 2). Because age of parents and offspring were highly correlated ($r = .95$) only the age of parents was included as a covariate. In a second step the mean scores of abuse and neglect in the nuclear family were simultaneously entered to evaluate whether each maltreatment type had unique associations with family cohesion (Model 3).

Bootstrap analyses

Because the dependent variables offspring-to-parent communication and dyadic affective dissimilarity were skewed to the right, we performed clustered bootstrap analyses on the final models to estimate standard errors and to determine confidence intervals for the model parameters (with a 5% error level). The advantage of this bootstrap method is that it yields correct standard errors and confidence intervals even when key assumptions of the mixed model are violated (Deen & De Rooij, 2016). Because data were multiply imputed and running the bootstrap for each imputed data set is very labor intensive, we randomly selected 5 imputed datasets on which the bootstrap analysis was performed. We examined whether the conclusions obtained from the bootstrap analyses paralleled the conclusions obtained from the mixed models.

Results

Preliminary analyses

Correlations between the pooled study variables are presented in Table S5.2 of the Supplementary material. Descriptive statistics and correlation of non-imputed variables can be found in Table S5.1 of the Supplementary material.

Table S5.2 shows that abuse was significantly negatively associated with parent-to-offspring communication ($r = -.24, p < .001$) and with offspring-to-parent communication ($r = -.22, p < .001$). Neglect was significantly negatively associated with offspring-to-parent communication ($r = -.13, p = .015$). Family cohesion was significantly positively associated with parent-to-offspring communication ($r = .15, p = .009$) and offspring-to-parent communication ($r = .34, p < .001$).

Dyadic parent-offspring interactions

Parent-to-offspring communication

Results of the mixed linear model on parent-to-offspring communication are presented in Table 5.1. The unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.42 at the parent level, indicating that 42% of the total variance in parent-to-offspring communication can be explained by differences between parents, i.e., the correlation

between parents' communication style with different offspring is 0.42. The proportion of explained variance (ICC) at the offspring level was 0.10, indicating that 10% of the total variance in parent-to-offspring communication was explained by differences between offspring, i.e., the correlation between fathers' and mothers' communication style with the same child is 0.10. Finally, 1% of the variance in parent-to-offspring communication pertains to differences between extended families, indicating that the correlation in parent-to-offspring communication between two parents within the same extended family is low. In a next step, covariates were included (Model 2). Of the covariates only gender of the offspring was significant ($t = 2.28$, $p = .023$), indicating that parents communicated more positively with daughters than with sons. The F -test indicated that Model 2 fitted the data better than Model 1 ($F(1, 8431) = 5.12$, $p = .024$). Abuse and neglect were included in the next step (Model 3). This model revealed that abuse was significantly negatively associated with parent-to-offspring communication ($t = -3.97$, $p < .001$), meaning that parents who perpetrated higher levels of abuse towards their offspring communicated more negatively with their offspring. Neglect was not associated with parent-to-offspring communication ($t = 0.02$, $p = .99$), suggesting no associations between parents' observed communication style and their neglectful behavior. In Model 4, family cohesion was included to examine associations between parents' communication and abuse when the level of family cohesion is held constant. This model showed that the association between abuse and parent-to-offspring communication remained significant ($t = -3.88$, $p < .001$) when family cohesion was controlled for, indicating that this association is independent of family cohesion. In addition, the F -test indicated improvement of model fit compared to Model 3 ($F(1, 2005) = 5.14$, $p = .023$).

Table 5.1. Parameter estimates of the mixed models on parent-to-offspring communication

		Model 1	Model 2	Model 3	Model 4
Fixed effects		Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept		5.47 (0.09)**	5.27 (0.12)**	5.28 (0.12)**	5.31 (0.12)**
Gender O			0.34 (0.15)*	0.32 (0.14)*	0.27 (0.14)
Abuse				-0.38 (0.10)**	-0.37 (0.10)**
Neglect				0.00 (0.09)	-0.01 (0.09)
Cohesion					0.17 (0.08)*
Variance components					
Parent level	Intercept	0.77	0.73	0.66	0.66
Offspring level	Intercept	0.17	0.17	0.15	0.11
Family level	Intercept	0.02	0.03	0.03	0.04

Note. Gender: 0 = male, 1 = female. O = Offspring. Interactions between maltreatment and gender and age were not significant ($p > .19$) and model fit did not improve, thus Model 4 was accepted as the final model. * $p < .05$, ** $p < .01$.

Offspring-to-parent communication

Results of the mixed linear model on offspring-to-parent communication are presented in Table 5.2. The unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.35 at the offspring level, and 0.08 at the parent level, and 0.02 at the family level. Covariates were included in Model 2. Only discussion of a problem was significantly associated with offspring-to-parent communication ($t = -2.93$, $p = .003$). Model 2 fitted the data significantly better than Model 1 ($F(1, 9031) = 8.21$, $p = .004$). Model 3 revealed that abuse ($t = -3.45$, $p = .001$) but not neglect ($t = -1.10$, $p = .27$) was significantly associated with offspring-to-parent communication, indicating that offspring with higher levels of experienced abuse communicated more negatively towards their parents. The F -test indicated improvement of model fit compared to Model 2 ($F(2, 22425) = 7.85$, $p < .001$). Inclusion of family cohesion in Model 4 showed that the association between abuse and offspring-to-parent communication remained significant ($t = -3.28$, $p = .001$) when family cohesion was held constant. In addition, the F -test indicated improvement of model fit compared to Model 3 ($F(1, 4209) = 26.81$, $p < .001$).

Table 5.2. Parameter estimates of the mixed models on offspring-to-parent communication

		Model 1	Model 2	Model 3	Model 4
Fixed effects		Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept		6.13 (0.11)**	6.90 (0.29)**	6.88 (0.28)**	6.66 (0.27)**
Problem			-0.86 (0.29)**	0.83 (0.29)**	-0.58 (0.28)*
Abuse				-0.39 (0.11)**	-0.35 (0.11)**
Neglect				-0.12 (0.11)	-0.17 (0.10)
Cohesion					0.41 (0.08)**
Variance components					
Parent level	Intercept	0.16	0.06	0.04	0.03
Offspring level	Intercept	0.88	0.82	0.73	0.48
Family level	Intercept	0.05	0.07	0.06	0.02

Note. Gender: 0 = male, 1 = female. Interactions between maltreatment and gender and age were not significant ($p > .30$) and model fit did not improve, thus Model 4 was accepted as the final model. * $p < .05$, ** $p < .01$.

Dyadic affective dissimilarity

Results of the mixed linear model on dyadic affective dissimilarity are presented in Table 5.3. An unconditional means model revealed that the variance of the extended family level was zero, and, therefore, was omitted from the model. The proportion of explained variance (ICC) was 0.13 at the offspring level, and 0.10 at the parent level. Inclusion of covariates in Model 2 revealed that only gender of the parent was significantly associated with dyadic affective dissimilarity ($t = 3.23$, $p = .001$), such that parents communicated more positively than offspring in case the parent was the mother. The fit of Model 2 proved

to be significantly better than the fit of Model 1 ($F(1,7662) = 9.91, p = .002$). Model 3 showed that abuse ($t = -2.10, p = .035$), but not neglect ($t = 1.90, p = .057$), was significantly negatively associated with dyadic affective dissimilarity. The F -test indicated improvement of model fit compared to Model 2 ($F(2, 9061) = 3.12, p = .04$). A scatterplot (see Figure S5.1 of the Supplementary material) revealed that parents who perpetrated no or low levels of abuse communicated more positively than their offspring, but the difference decreased with increasing levels of abuse. Model 4 showed that the association between abuse and dyadic affective dissimilarity remained significant ($t = -2.35, p = .019$) when family cohesion was held constant. In addition, the F -test indicated improvement of model fit compared to Model 3 ($F(1, 7327) = 11.21, p = .001$). Finally, this model revealed a significant positive association between neglect and dyadic affective dissimilarity. A scatterplot (see Figure S5.2 of the Supplementary material) revealed that offspring of parents who perpetrated higher levels of neglect communicated more negatively than their parents, but the difference decreased with decreasing levels of neglect.

Table 5.3. Parameter estimates of the mixed models on dyadic affective dissimilarity

		Model 1	Model 2	Model 3	Model 4
Fixed effects		Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept		0.46 (0.08)**	0.22 (0.11)	0.18 (0.11)	0.18 (0.10)
Gender P			0.45 (0.14)**	0.51 (0.14)**	0.52 (0.14)**
Abuse				-0.20 (0.09)*	-0.22 (0.09)*
Neglect				0.17 (0.09)	0.19 (0.07)*
Cohesion					-0.21 (0.06)**
Variance components					
Parent level	Intercept	0.16	0.12	0.13	0.09
Offspring level	Intercept	0.21	0.27	0.27	0.23

Note. P = Parent. Gender: 0 = male, 1 = female. Interactions between maltreatment and gender and age were not significant ($p > .18$) and model fit did not improve, thus Model 4 was accepted as the final model. * $p < .05$, ** $p < .01$.

Family cohesion

Results of the stepwise multilevel linear regression analysis on family cohesion are presented in Table 5.4. The unconditional means model (Model 1) revealed that the proportion of explained variance (ICC) was 0.36 at the extended family level, indicating that 36% of the total variance in family cohesion pertains to differences between extended families, i.e., the correlation between two nuclear families from the same extended family is 0.36. Covariates were included in Model 2. Age of parents, gender of parents and offspring, SES of parents and offspring and family size were significantly associated with family cohesion ($t_{\text{range}} = 2.32 - 4.47$), indicating that family cohesion was higher in families with a higher mean family age, in families where a father participated in the task, families with

more female children, parents with a higher SES and offspring with a lower SES. The *F*-test indicated that Model 2 fitted the data better than Model 1 ($F(6, 6671) = 9.13, p < .001$). Model 3, with inclusion of abuse and neglect, showed no significant associations between family cohesion and abuse ($t = -0.67, p = .500$) and neglect ($t = 0.81, p = .417$), and no improvement of model fit compared to Model 2 ($F(2, 46015) = 0.49, p = 0.612$). Thus, the level of abuse and neglect that occurred within the nuclear family was not associated with observed family cohesion.

Table 5.4. Parameter estimates of the multilevel linear regression models on family cohesion

		Model 1	Model 2	Model 3
Fixed effects		Coef (se)	Coef (se)	Coef (se)
Intercept		-0.07 (0.11)	-0.14 (0.11)	-0.13 (0.11)
Age P			0.02 (0.01)**	0.02 (0.01)**
Gender P			-0.79 (0.26)**	-0.75 (0.27)**
Gender O			0.76 (0.17)**	0.74 (0.17)**
HHSES P			0.41 (0.13)**	0.40 (0.13)**
HHSES O			-0.41 (0.18)*	-0.40 (0.18)*
Family size			-0.39 (0.09)**	-0.40 (0.09)**
Abuse				-0.08 (0.11)
Neglect				0.08 (0.10)
Variance components				
Nuclear family level	Intercept	1.00	0.81	0.81
Extended family level	Intercept	0.55	0.60	0.58

Note. P = Parent, O = Offspring. Gender: 0 = male, 1 = female. * $p < .05$, ** $p < .01$.

Bootstrap analyses

All results were replicated in all out of the five bootstrap analyses, except for the association between neglect and dyadic affective dissimilarity. Neglect was significantly associated with dyadic affective dissimilarity in four out of five bootstrap analyses.

Discussion

The aim of the present study was to investigate the associations between abuse and neglect, dyadic parent-offspring interactions and family cohesion in an extended family study. Parents who perpetrated higher levels of abuse towards their offspring interacted more negatively with their offspring, and offspring who experienced a higher level of abuse communicated more negatively with their parents. Furthermore, parent-offspring interactions were more dissimilar in dyads characterized by higher levels of neglect,

but not in dyads characterized by higher levels of abuse. In addition, findings showed similarity in parenting behavior across siblings and some similarity in parenting behavior displayed by two parents of the same offspring. Surprisingly, we found no association between family cohesion and maltreatment.

Our first hypothesis was partly confirmed. We found that parents and offspring communicated more negatively towards each other in dyads marked by higher levels of child abuse, but not in dyads marked by higher levels of child neglect. This finding is consistent with previous studies that observed more negative and less supportive behavior in abusive parents compared to non-maltreating parents (e.g., Lau et al., 2006; Wilson et al., 2008). The present results are also in line with findings that abused children emit more frequent aversive child behaviors than non-maltreated children during parent-offspring interactions (e.g., Cerezo & D'Ocon, 1999). It has been suggested that these behaviors might be reinforced because they attract the attention of abusive parents who tend to respond inconsistently to children's positive behaviors. Our findings suggest that child abuse might be part of an overall disrupted parent-offspring relationship, rather than limited to 'occasional' occurrences of abusive behavior. Such a disrupted parent-offspring relationship might be a mechanism that contributes to the negative consequences of child maltreatment. It is important to note that a considerable part of our sample consisted of parent-*adult* offspring dyads. No interactions between age and maltreatment were found which may suggest that the association between childhood maltreatment and parent-offspring interactions is not dependent on whether the maltreatment is still ongoing or has happened several years ago. This is particularly worrisome since the parent-offspring relationship not only provides the foundation for a healthy development (e.g., Eisenberg et al., 2001), but also continues to be of importance during adulthood (Van Wel, Linssen, & Abma, 2000).

Contrary to the handful of studies that observed parent-offspring interactions in neglectful parents (Wilson et al., 2008), we did not find an association between neglect and parent or offspring individual behavior. However, the majority of these studies observed differential parent behavior as a function of neglect in the form of less involvement. We did not examine the level of involvement, rather we examined the presence of negative and positive behavior. Moreover, the task as used in the current study "forced" participants to interact with each other. Finally, it should be noted that the majority of studies that included neglectful parents did not statistically control for other types of maltreatment, leaving open the possibility that co-occurring experiences of abuse accounted for the associations between neglect and parent-offspring interactions.

Contrary to our expectations, results showed more dyadic affective similarity in parent-offspring dyads of which the parents perpetrated higher levels of abuse. Parents who perpetrated low levels of abuse interacted more positively than their offspring, but the difference between parental and offspring affective behavior decreased with increasing levels of abuse. One possible explanation for this finding is that non-maltreating parents

are better able to handle the negative behavior of their offspring and maintain a positive stance as a means to keep the interaction positive, whereas abusive parents are more reactive to changes in the mood that offspring display. Indeed, research has shown that abusive parents are hyperreactive to the misbehavior of their children during laboratory experiments and become more annoyed than non-maltreating parents and neglectful parents (Bousha & Twentyman, 1984). In addition, it has been reported that abusive parents tend to feel that they have no control over stressful interactions with their children (Bugental & Happaney, 2004).

Our hypothesis regarding more dyadic affective dissimilarity was confirmed for neglect. Results showed that parents and offspring interacted in a more similar manner in dyads marked by low levels of neglect, whereas offspring communicated more negatively than parents in dyads marked by higher levels of childhood neglect. It might be the case that offspring who experienced higher levels of neglect have less positive feelings towards their parents, whereas neglectful parents are - unlike abusive parents - not more negative in their interactions. This finding, however, should be interpreted with caution since it was not always confirmed in our bootstrap analyses. Replication in future studies is warranted.

In accordance with previous studies, there was substantial similarity in parenting behavior across siblings (Browne et al., 2012; Jenkins et al., 2003), whereas correspondence between parenting behavior of two parents within the same nuclear family was modest. This may suggest that parenting behavior as measured in our study was more parent-driven than child-driven. Thus, parental behavior while discussing conflict may be better explained by factors such as parents' personality or parents' history of childhood adversities than by child-specific factors, such as child gender or child age. Interestingly, the modest similarity in parenting behavior of two parents with the same offspring could not be attributed to parental gender, whereas previous studies observed higher levels of sensitive and nonintrusive behavior in mothers than in fathers (e.g., Hallers-Haalboom et al., 2017). However, most studies have been conducted with infants and toddlers, whereas our study included offspring across a wide developmental range, which may explain the difference. Fathers with older children are more sensitive and nonintrusive than fathers with younger children (Bergmann et al., 2013), and differences between mothers and fathers may become smaller when children are older and the division of childcare becomes more equal (Yeung et al., 2001).

Surprisingly and in contrast with previous investigations (e.g., Howes et al., 2000) family cohesion was not associated with maltreatment. Thus, family cohesion might still be intact even though maltreatment takes place within parent-offspring dyads in the family. However, it is also possible that we failed to observe an association between maltreatment and family cohesion, because only the most cohesive families entered the laboratory together to participate in the tower building game. During data collection, we sometimes experienced difficulties to schedule all nuclear family members on the same

day suggesting some reluctance among some family members to enter the laboratory together. To date, no other observational studies have investigated the association between maltreatment and both family cohesion and dyadic parent-offspring interactions. Future studies should replicate our results before firm conclusions can be drawn.

Strengths & limitations

The current study is one of very few observational studies on childhood maltreatment and parent-offspring interactions that included both fathers and mothers and multiple offspring across a wide age range, enabling a better understanding of maltreatment and parent-offspring interactions in the context of the family. In addition, parent and child reports of maltreatment were combined to minimize the influence of individual reporter bias. Finally, our study differentiated between effects of abuse and neglect, whereas effects of neglect are often 'neglected' in previous studies.

One limitation of this study is the use of retrospective reports to measure maltreatment, which can be subject to greater measurement error and false negatives due to recall bias (Hardt & Rutter, 2004). However, we combined parent and child reports in the maltreatment scores reducing individual bias. A second limitation is the correlational design of the study, which precludes drawing inferences about the direction of our findings. Disturbed parent-offspring interactions may precede or follow child maltreatment. Alternatively, it may be a transactional process with maltreatment causing negative interactions and negative interactions escalating toward child maltreatment. Further, although examining parent-adult offspring relationships fills a gap in the literature, it is also a limitation to include offspring across a wide developmental range since the parent-offspring relationship changes across the lifespan (McGue, Elkins, Walden, & Iacono, 2005). Nevertheless, research also points to considerable stability in parent-offspring relationship quality (Belsky et al., 2001). Moreover, we found no interactions between age and maltreatment indicating that the associations between maltreatment and parent-offspring interactions are independent of offspring's age. Finally, our laboratory interactions may have not elicited interactions as they naturally occur in home environments. Future studies might consider using longer observation periods and home observations, which may elicit typical parenting and offspring behavior to a greater extent.

Conclusion

In sum, we found that parents and offspring displayed more aversive behavior in parent-offspring dyads characterized by higher levels of child abuse, but not in dyads characterized by higher levels of child neglect. Moreover, more dyadic affective dissimilarity was found in parent-offspring dyads characterized by higher levels of neglect, and less dyadic affective dissimilarity in dyads characterized by higher levels of abuse. This finding underscores the importance to distinguish between abuse and neglect in research and in

practice. Moreover, we found substantial similarity in parenting behavior across siblings and modest similarity in parenting behavior between parents residing in the same home, highlighting the importance of including both parents in research on maltreatment. Our results suggest that child maltreatment often accompanies a disrupted parent-offspring relationship, which may contribute to the detrimental consequences of child maltreatment. Interventions focused on parent-offspring interactions (i.e., Parent-child interaction therapy; Batzer et al., 2015) may be effective in establishing non-coercive and non-violent relationship patterns between parents and children, eventually reducing the negative consequences of child maltreatment.

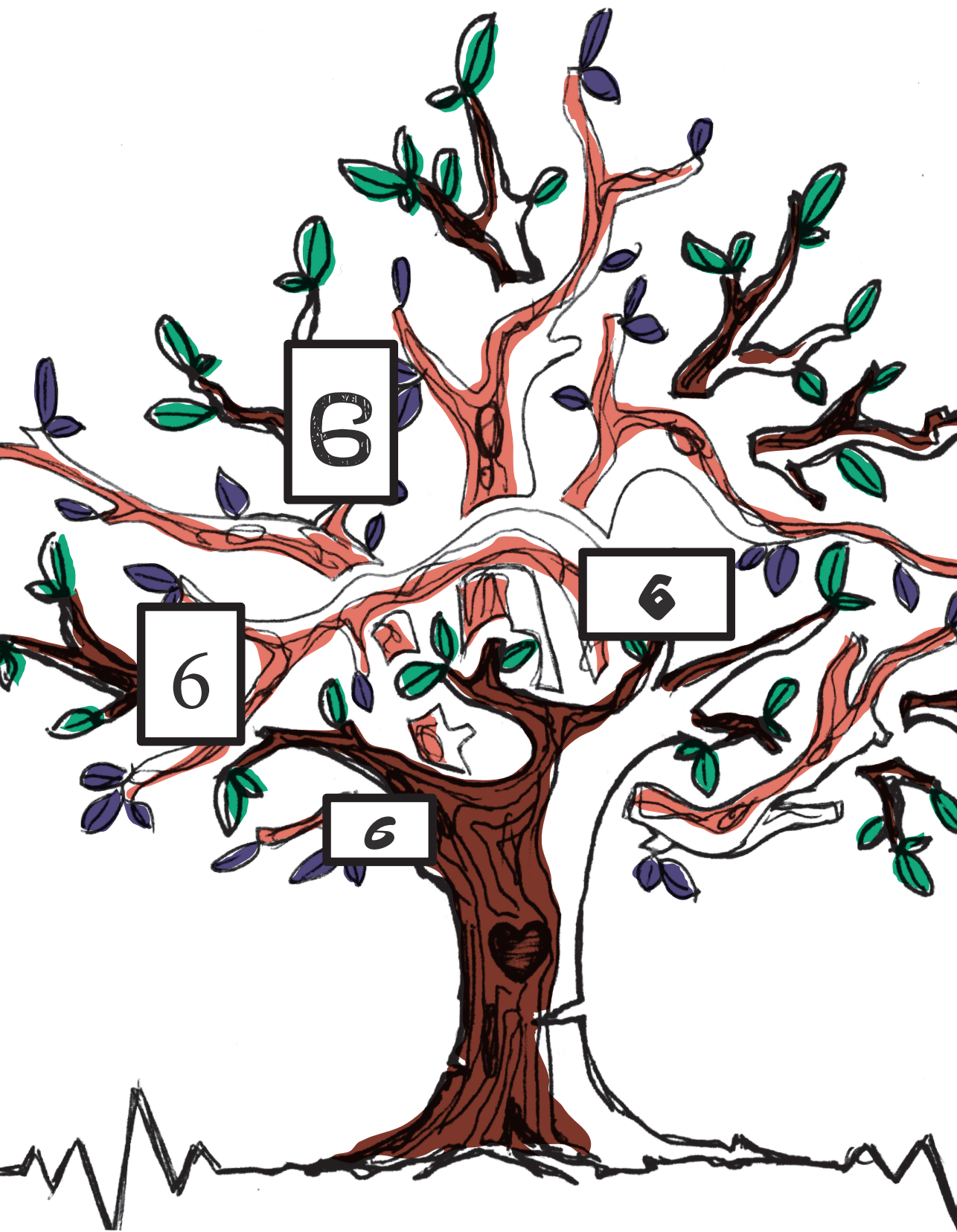
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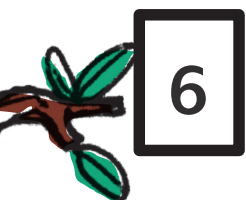
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Chapter 6

General discussion



General discussion

The aim of this dissertation was to gain more insight into the etiology and sequelae of child maltreatment using a multidimensional multi-method investigation in extended families. First, we examined the intergenerational transmission of child maltreatment (ITCM) with a central focus on the role of reporter effects. A principal-component-analytic approach that combined father, mother and child reports was used to test ITCM. This approach was compared to two more common approaches: ITCM based on one reporter and ITCM based on different reporters from each generation. Intergenerational transmission of abuse was consistently found across approaches, whereas intergenerational transmission of neglect was only found using the perspective and data of one single reporter (Chapter 2).

In the next chapters we zoomed in on antecedents and consequences of child maltreatment that might play a role in ITCM, and examined these in several (pseudo-) parenting contexts. Findings showed that parents' perceptions of infant emotional sounds did not differ according to their childhood maltreatment experiences. However, childhood maltreatment experiences were associated with parents' behavioral and autonomic responses in the parenting context (Chapters 3 and 4). First, higher levels of neglect were related to using more handgrip force during infant crying and using less handgrip force during infant laughter. In addition, parents who experienced higher levels of childhood neglect exhibited elevated autonomic activity during baseline, during listening to infant emotional signals, and while discussing conflict with their offspring. Parents who experienced higher levels of abuse showed more warmth and less negativity while discussing conflict with their offspring.

Besides focusing on correlates of child maltreatment at the individual (i.e., parent) level, we also focused on correlates of child maltreatment in the family context. Results demonstrated that parent-offspring interactions were less similar in dyads characterized by higher levels of neglect, and more similar in dyads characterized by higher levels of abuse. Family cohesion was not associated with child maltreatment (Chapter 5).

In the following sections we will elaborate on the differential results that were found for child abuse and neglect, on including a multilevel perspective in child maltreatment research, and on the utility of advanced statistical techniques in answering complex research questions in our field. Limitations and directions for future research and interventions will also be discussed.

Measurement of abuse and neglect and the intergenerational transmission

Among the many deleterious consequences, one subsumed consequence of child maltreatment is that victims may themselves become perpetrators of child maltreatment. The “cycle of maltreatment” hypothesis (Thornberry, Knight, & Lovegrove, 2012) has been extensively discussed and examined in the past few decades. Although the majority of research has found evidence in support of the intergenerational maltreatment hypothesis, transmission is by no means inevitable (Madigan et al., 2019). Rates of transmission vary considerably across studies: the percentage of maltreated children who become maltreating parents varies from 6.7 to 40% (Dixon et al., 2005; Egeland, Jacobvitz & Sroufe, 1988; Pears & Capaldi, 2001). Variation in transmission rates can be due to methodological biases, including poor operational definitions of maltreatment, single informants for the assessment of maltreatment in different generations, and an absence of prospective studies. Findings from a systematic review suggest that there is less evidence for the “cycle of maltreatment” hypothesis in studies with higher methodological rigor (Thornberry et al., 2012). Yet, a recent meta-analysis of ITCM studies (Madigan et al., 2019) revealed that solely the effect size for the transmission of physical abuse decreased with increasing study quality, but there was little indication that study methodological quality affected effect sizes for the transmission of other types of maltreatment.

One methodological aspect of ITCM was addressed in the current dissertation: the use of single-informant vs. multi-informant approaches. Intergenerational transmission of abuse was consistently found across approaches – from the perspective of one reporter, from the perspective of different reporters from each generation and with a component-analytical approach that combined father, mother and child reports. Yet, intergenerational transmission of neglect was only found using a single informant for the assessment of maltreatment in different generations. Because including multiple perspectives may increase validity due to reduction of random error and systematic bias (Thornberry et al., 2012), the validity of transmission of neglect may be called into question. Our finding that transmission of neglect was only found using a less rigorous method, whereas transmission of abuse was found across methods, may seem to deviate from the finding of the meta-analysis of Madigan and colleagues’ (2019) that effect sizes weakened for the transmission of physical abuse with increasing study quality. However, we only investigated one methodological aspect, i.e., using single vs. multiple informants. This aspect may be particularly relevant when comparing transmission rates of abuse and neglect. Abuse describes the presence of behavior whereas neglect describes the absence of behavior. It is possible to estimate the presence of behavior without judging its adequacy (e.g., My mother/ father shouted, yelled or screamed at me), whereas estimating the absence of behavior requires a judgment whether the behavior should have been present (e.g., My father/mother was not able to make sure that I got to the doctor or hospital when needed).

Hence, the measurement of neglect might be more subjective than the measurement of abuse, resulting in more disagreement between parents and children, which complicates combining their scores. Although research has shifted more towards studying neglect, continued efforts are needed to improve its assessment.

Finally, it is worth noting that there is no perfect measure or method that can completely and correctly identify all types of maltreatment. Error or “noise” is common in all scientific methods, and perhaps even more common in a field examining such a sensitive phenomenon as child maltreatment. The data-driven approach (i.e., PCA) that we used to combine reports of multiple informants, therefore, should not be viewed as the “single best method” to estimate child maltreatment, rather as a method to combine reports of different informants that also takes the unique perspectives of informants into account. For a component reflecting abuse, similar weights were obtained for child, father and mother reports. This indicates that the score on this component was virtually equivalent to a mean score of the three reporters. Thus, for researchers primarily interested in a combined multi-informant score of abuse a mean score may suffice. For the component reflecting convergence on neglect, child report was given less weight, because disagreement between child and parent reports was higher than disagreement between father and mother reports. Yet, theoretically, there seems little reason to give child reports less weight than parent reports when estimating the occurrence of child maltreatment. Ultimately, decisions on the method of combining maltreatment reports should be guided by the specific research question. For research questions that underlie a hypothetical process, a theory-driven approach might be more appropriate than a data-driven approach to combine informants.

Differential correlates of abuse and neglect

We distinguished between abuse and neglect when examining the antecedents and consequences of child maltreatment. Results suggest that abuse (i.e., the *commission* of inadequate care) is more strongly associated with behavioral responses, whereas neglect (i.e., the *omission* of adequate care) is more strongly associated with physiological responses.

Parents who experienced higher levels of childhood neglect showed autonomic *hyper-(re)activity* during baseline, during listening to infant emotional signals, and while discussing conflict with their offspring. One possible explanation for these findings may be that neglect is – even more so than abuse – a pervasive chronic stressor that jeopardizes adequate functioning of the autonomic nervous system (De Bellis, 2005). Recurrence of neglect has been shown to be higher than recurrence of abuse (Jonson-Reid, Drake, Chung, & Way, 2003; Lipien & Forthofer, 2004), and neglect seems more intractable to intervention (i.e., MacMillan et al., 2005). Hence, neglect is often described as a chronic problem that is difficult to resolve (Hildyard & Wolfe, 2002). Exposure to a chronic stressor, such as

neglect, may cause dysregulation of physiological systems, i.e., allostatic load (Danese & McEwen, 2012) resulting in *hyper*-(re)activity of the autonomic nervous system (ANS) – as was found in the current dissertation. Interestingly, similar patterns of autonomic *hyper*-reactivity to stressors have been found in foster children who experienced chronic neglect (Oosterman, Schipper, Fisher, Dozier, & Schuengel, 2010) and children who were adopted out of institutions – which can be considered an extreme form of neglect (Gunnar, Frenn, Wewerka, & Ryzin, 2009). Yet, elevated ANS activity has also been associated with a history of childhood abuse (e.g., Heim, 2000). However, neglect was not statistically controlled for in the analyses, making it unclear to what extent neglect may have accounted for this association. Moreover, although neglect often involves chronic situations (Hildyard & Wolfe, 2002; Lipien & Forthofer, 2004), abuse may also follow a chronic pattern. To date, there is no other research that examined the unique effects of both abuse and neglect on ANS reactivity within the same study. Our findings need to be replicated in future studies that also take maltreatment chronicity into account, to confirm and understand the differential consequences of abuse and neglect on ANS functioning.

We also demonstrated that parents who experienced higher levels of abuse were less warm and more negative while discussing conflict with their offspring. Lower levels of warmth and higher levels of negativity, in turn, were shown to be associated with parental abusive behavior. Contrary to neglect, abuse may be more strongly associated with the behavioral system via the learning of maladaptive behavioral patterns. According to social learning theory (Bandura, 1973), individuals learn to exhibit aggressive behaviors because they observe others acting aggressively and because they are positively reinforced when exhibiting aggressive behaviors. Such an aggressive interpersonal style may also translate into a set of parenting beliefs or behaviors likely to be transmitted from one generation to the next. This, however, may apply less to behaviors that are more automatically controlled. For example, we also found that neglect, but not abuse, was associated with the modulation of handgrip force while listening to infant crying and laughter. Modulation of handgrip force can be considered a form of unconscious behavior difficult to control or to model.

Finally, our findings may also indicate that parents with childhood experiences of abuse or neglect are more likely to engage in that same type of maltreating behavior towards their own offspring, referred to as homotypic intergenerational continuity of maltreatment (Madigan et al., 2019). Parents who experienced more childhood abuse displayed less warm and more negative behavior towards their offspring, which is typically also observed in abusive parents (e.g., Borrego, Timmer, Urquiza, & Follette, 2004; Wilson, Rack, Shi, & Norris, 2008). The transmission of neglectful behavior, on the other hand, may be more difficult to observe. Neglectful parents are generally characterized by a lack of involvement (Wilson, et al., 2008), which might be unobservable during a task where they are “forced” to interact with their offspring. Instead, these parents may experience more stress as a result, which may – in part – explain their elevated ANS response.

A multiple-levels-of-analysis perspective on child maltreatment

In the current series of studies we concurrently examined cognitive-affective, physiological, behavioral, and family environmental processes aiming to gain more insight into the complex nature of child maltreatment. During a standardized handgrip paradigm parents' perceptions, behavior and ANS functioning while listening to infant crying and laughter were simultaneously examined. As described and explained above, higher levels of neglect were associated with stronger ANS responses while listening to infant cry and laughter sounds. In addition, higher levels of neglect were related to more handgrip force during infant crying and less handgrip force during infant laughter. However, parents' appraisals of infant emotional signals did not vary as a function of their maltreatment experiences. In addition, parents' appraisals of infant crying and laughter were not correlated with their autonomic and behavioral responses to these infant emotional sounds. Together, these findings indicate that the effects of maltreatment on emotional responding to infant signals operate mainly at an unconscious level. Thus, parents who experienced higher levels of childhood neglect seem unaware of their physiological and behavioral responses elicited by infant emotional signals.

In addition, findings indicated that parents' history of neglect may affect their ANS responses. Physiological regulation, in turn, has been postulated to underlie parental behavior responses (e.g., Bridges, 2008) but our data supported this only to some extent. No correlations were found between parental behavioral responses and their ANS reactivity to infant emotional signals. Moreover, parasympathetic nervous system (PNS) reactivity was only associated with negativity, but not with warmth or emotional support, such that parents who exhibited *decreased* PNS reactivity showed more negativity while discussing conflict with their offspring. This finding was unexpected, since *increased* PNS reactivity (i.e., vagal withdrawal) is generally assumed to accompany negative emotional states (Beachaine, 2001). Indeed, in the parenting context, increased PNS withdrawal has been found in parents who displayed more negative behavior, i.e., use of harsh discipline, towards their offspring (Lorber & O'Leary, 2005). Nevertheless, PNS withdrawal has also been found in mothers displaying less negative (i.e., intrusive) behavior but only among mothers with high cortisol levels (Mills-Koonce et al., 2005). PNS withdrawal may have protected parents from displaying negative behavior when they experience either chronic or acute stress. This hypothesis could not be tested in our study as we did not measure cortisol. Future studies could consider using markers of both ANS and HPA-axis reactivity to disentangle associations between biological systems and parenting behaviors. We also explored if ANS reactivity mediated the association between neglect and behavioral responses. Results revealed that this was not the case, indicating that ANS activity was not a mechanism underlying the effects of childhood maltreatment on parenting behavior. Because parenting is a complex of multiple behaviors, cognitions, and emotions involving multiple neural circuits (Kohl, Autry, & Dulac, 2017) assessing markers

of multiple physiological systems is needed to fully explain how parents' biology shapes their parenting behavior.

Although our examination of the biological underpinnings of child maltreatment was limited to one physiological system (i.e., the ANS), we did examine multiple autonomic measures to clarify the concept of autonomic arousal. First, we included both measures of the sympathetic (SNS) and PNS. Overall, findings of Chapter 4 suggest that both the PNS and SNS are affected by childhood maltreatment, such that parents who experienced higher levels of neglect exhibited more PNS withdrawal and greater SNS activity in a stressful parenting context, indicative of autonomic *hyper*-reactivity. Interestingly, similar patterns of ANS reactivity have been found when participants with a history of childhood maltreatment reacted to psychosocial stressors in general (Heim et al., 2000; Dale et al., 2009). In addition, we distinguished between so-called trait-related (measured during rest) and state-related (measured during a task) measures of ANS activity. Parents who experienced higher levels of childhood neglect also exhibited higher basal ANS activity, indicative of elevated autonomic arousal regardless of the specific demands of the environment. Whereas ANS reactivity indicates how an individual responds to a stressor, i.e., a state, sustained autonomic activation is assumed to more generally reflect the capacity to regulate emotions, i.e., a trait (Brosschot et al., 2005; Reijman et al., 2016).

Finally, child maltreatment was examined in the context of the family. In line with previous studies (Wilson et al., 2008; Cerezo & D'Ocon, 1999) we found that not only parents but also their offspring communicated more negatively in parent-offspring dyads marked by higher levels of child abuse. This may suggest that child abuse is part of an overall distorted parent-offspring relationship, rather than limited to occasional incidents of inadequate parenting behavior. In line with previous studies (Giuliano, Skowron, & Berkman, 2015; Skowron, Kozlowski, & Pincus, 2010), parents and offspring also showed more interactive affective mismatch, i.e., higher dyadic affective dissimilarity, in dyads marked by higher levels of neglect. Yet, unexpectedly, dyadic affective similarity was higher in dyads marked by higher levels of abuse. A scatter plot (see Supplementary material, Figure S5.1) revealed that parents who perpetrated low levels of abuse communicated more positively than their offspring but the difference in communication between parents and offspring decreased with increasing levels of abuse. It might be that non-maltreating parents are more skilled in maintaining a positive stance to keep the interaction positive despite negative behavior of their offspring, whereas maltreating parents are more reactive to offspring's displays of negativity. Indeed, research has shown that abusive parents are *hyper*-reactive to aversive behavior displayed by their children and become more easily annoyed than non-maltreating and neglectful parents (Bousha & Twentyman, 1984).

Because we examined both maternal and paternal interactions with offspring spanning a wide age range, we also explored moderating effects of gender and age. Interestingly, none were found, indicating that the association between child maltreatment and parent-

offspring interactions is not different for fathers or mothers, and may not be dependent on whether the maltreatment happened recently or has happened several years ago. The latter finding seems particularly worrisome, considering that the parent-offspring relationship not only provides the foundation for future relationships (e.g., Bowlby, 1969), but in general also continues to play an important role during adulthood (Van Wel, Linssen, & Abma, 2000). Finally, although we observed more positive parent-offspring interactions in more cohesive families, family cohesion was not associated with child maltreatment. This indicates that family cohesion might still be intact despite incidences of child maltreatment within specific parent-offspring dyads in the family. However, we also consider it a possibility that we failed to observe lower family cohesion in families marked by higher levels of child maltreatment, because observations of cohesion in the least cohesive families were not included. During data-collection, we noticed that with some families it was impossible to schedule all family members on the same day, which may indicate reluctance among certain family members to enter the laboratory together.

Advanced statistical techniques in child maltreatment research

Studying the complex multidimensional nature of child maltreatment is methodologically challenging and goes hand in hand with the application of more complex research designs. Although their use is far from being standard practice in the child maltreatment field, advanced statistical techniques, which increasingly become available, may offer solutions to these methodological challenges.

First, our three-generational extended family design enabled us to examine family-level correlates of child maltreatment. Yet, the family represents a complex, hierarchical structure in which multiple children and parents from the same family are not independent from one another. Ignoring the family level, and conducting the analysis at the parent or child level, might result in underestimation of the standard errors of regression coefficients leading to invalid statistical inferences. Moreover, if the family-unit is left out of the model, important questions about family contextual effects cannot be explored (Jenkins, Rasbash, & O'Connor, 2003). Despite the recognized importance of incorporating family system notions into child maltreatment research and practice (e.g., Cicchetti & Toth, 1995), few studies have actually assessed family context effects. We, therefore, explicitly modelled family level effects using modern multilevel modelling techniques. Multilevel models, also known as random effects models and hierarchical linear models provide a flexible regression modelling framework for handling data sampled from clustered population structures (Hox, 2002). In addition, in one of our studies we investigated the association between child maltreatment and parent-offspring interactions including multiple parents and multiple offspring, which enabled us to examine the similarity in parenting behavior across siblings and across parents. In doing so, we added another complexity to the data structure, since offspring were nested within parents (parents participated with multiple

offspring) and parents were nested within offspring (offspring participated with father and mother), implying multiple crossed random effects. In the past it was difficult to fit mixed models with multiple, crossed grouping factors to relatively large, unbalanced, data sets. However, with the methods in the lme4 package (Bates, Maechler, Bolker, & Walker (2015) for R (R Core Team, 2018) we were able to do this. Considering the rapid development and availability of specialized multilevel modeling techniques, there seems little reason for researchers in our field to refrain from investigating child maltreatment in the context of the family.

Furthermore, in the current dissertation correlates of maltreatment were assessed at multiple levels of functioning. First generation multivariate methods, like multiple regression, are appropriate for evaluating relations between constructs but do not allow simultaneous evaluation of different dependent variables. Evaluation has to be performed in sequential steps. Second generation multivariate methods, like Path Analysis, allow for the simultaneous analysis of the relations between dependent variables as well as between independent variables and dependent variables (Tabachnick & Fidell, 2001; Jeon, 2015). A second advantage of Path Analysis is, that it permits decomposing correlations among variables to enhance interpretation of relations and the pattern of the effects of one variable on another. A total effect, a direct effect and an indirect effect can be tested via mediation (Jeon, 2015). We used Path Analysis to examine the direct effects of childhood maltreatment on both autonomic and behavioral responses, and to explore an indirect effect of autonomic reactivity in the association between childhood maltreatment and behavioral responses. Fortunately, Path Analysis has become increasingly available for researchers since the introduction of software such as LISREL, AMOS, and R.

Finally, recruiting families is challenging which may result in moderate to high rates of missingness due to family members not willing or not able to participate. Yet, the risk of missingness should not withhold researchers from conducting family studies, since modern techniques for handling missing data such as Multiple Imputation (MI) offer compelling solutions. MI is considered the “gold standard” for handling missing data, because it produces less bias than other typical methods (Allison, 2002; Graham, 2009). MI has been shown to be statistically sound especially for large percentages of missing values as wider confidence intervals will be generated for variables with more missing data, avoiding the risk of false positives (Graham, 2006). While the use of MI appears to be on the rise (Sterne et al., 2009) it is far from common. Reviews of the handling of missing data in various fields showed that only a handful of studies used MI (i.e., Sullivan, Yelland, Lee, Ryan, & Salter, 2017; Rombach et al., 2016). While examining the role of reporter effects in ITCM, and parent-offspring interactions and child maltreatment in the context of the family, we were able to accurately impute data by means of MI - imputations converged across datasets and correlations between variables were approximately similar for non-imputed and multiply imputed data. Thus, examining family-level correlates of child maltreatment or

exploring reporter effects of ITCM does not require complete families. Yet, it is worth noting that MI is a complex time-consuming technique and there may be practical reasons not to perform MI. For example, when we investigated the role of childhood maltreatment in parents' responses to infant emotional signals we decided not to use MI, because whole trajectories of participants were missing, i.e., participants had missing data on all repeated measurements. It is impossible to predict someone's trajectory by means of predictors measured at one occasion, so MI, or any other imputation technique, was not deemed feasible. In addition, another sound imputation technique may be implemented in the analysis, making it unnecessary to perform MI. For example, we used Path Analysis to examine the association between a history of childhood maltreatment and parents' behavioral and autonomic responses while discussing conflict with their offspring. Path Analysis incorporates a Full Information Maximum Likelihood (FIML) estimation method. FIML handles missing data within the analysis model, rather than replacing or imputing the data. The model is estimated by a FIML method, meaning that all available information is used to estimate the model. MI and FIML have been shown to produce similar results when outcome data are missing and the same information is incorporated in a multiple imputation model as in a full information maximum likelihood estimation (Collins, Schafer & Kam, 2001). Lastly, when only a small amount of the data is missing (e.g., less than 5%), it can be questioned whether the benefits of using MI outweigh the costs.

General limitations

The research presented in this dissertation has some limitations. First, retrospective reports were used to measure maltreatment, which may be subject to measurement error and recall bias (Hardt & Rutter, 2004). Yet, it has been shown that false positives are rare in retrospective reports of child maltreatment, and retrospective and prospective reports are approximately similarly associated with psychopathology, indicating that reporting bias due to current psychopathology is minimal (Hardt & Rutter, 2004; Scott, McLaughlin, Smith, & Ellis, 2012). Moreover, whenever possible, we combined parent and child reports in the maltreatment scores reducing individual bias.

Second, the findings presented in this dissertation are correlational, precluding conclusions about causality. However, although causal inferences can be made from intervention studies with a prospective design, experimental research on humans that evoke child maltreatment is unethical.

Third, due to the three-generational design of our study, the age range of parents and offspring was quite large, limiting conclusion about the effects of maltreatment during specific developmental periods. In addition, we examined the association between parent-offspring interactions and child maltreatment, whereas the nature of parent-offspring relationships changes across the lifespan (Buhl, 2007; McGue, Elkins, Walden, & Iacono, 2005). Nevertheless, the *quality* of the parent-offspring relationship has been

shown to be quite stable across the lifespan (Belsky, Jaffee, Hsieh, & Silva, 2001; Dalton, Frick-Horbury & Kitzmann, 2006). An advantage of the design of the current study is that it allowed us to cover parenting experiences across the entire span of growing up for most participants. Lastly, age was included as a covariate in all of our analyses and age did not moderate our findings presented in Chapter 5, suggesting that the associations between child maltreatment and parent-offspring interactions are independent of offspring's age.

It is further of note that the current study is not representative of the general population. First, because we oversampled for child maltreatment to compensate for the potential underrepresentation of maltreating parents in general population sampling. Second, the majority of participants in our study were Caucasian. Findings presented in the current dissertation, therefore, require replication in different populations and different settings.

Recommendations for future research and interventions

Findings presented in this dissertation highlight the need for future research and interventions to distinguish between abuse and neglect, despite their high co-occurrence (Herrenkohl & Herrenkohl, 2009). Our findings suggest that neglect is more strongly associated with physiological responses, whereas abuse may be more strongly associated with behavioral responses. Replication in future studies that also include neurophysiological measures is needed to confirm and to further our understanding of the differential correlates of abuse and neglect. Meanwhile, our findings may provide a basis for more tailored interventions. Specifically, parents with a history of neglect could benefit from interventions based on bio-feedback to help them to become aware of their physiological responses and to successfully regulate these responses in order to promote sensitive parenting. In contrast, abusive parents and their offspring, and parents with a history of abuse may benefit more from interventions that directly target their behavioral responses, such as parent-child interaction therapy (e.g., Batzer et al., 2015).

Furthermore, it might be worthwhile to include multiple informants when examining child maltreatment to overcome reporter bias and to provide a more comprehensive picture. This may be particularly relevant when estimating ITCM, since reliance on a single reporter who reports on his/her own perpetration and on the perpetration of maltreatment by his/her parents obviously violates the basis assumption of all science that measures of the independent and dependent variables are independent (i.e., Thornberry et al., 2012). However, in line with previous studies (e.g., Chan, 2015), we found modest convergence in child and parent perspectives on reported maltreatment. Yet, we would argue that precisely this divergence makes it relevant to include and to explore the role of multiple reporters, since different reports may lead to different conclusions (Kobulsky, Kepple, Holmes, & Hussey, 2017). When examining the role of reporter effects in ITCM different conclusion were reached for neglect (but not for abuse) when multiple reporters were included. However, similar associations were found between parents'

history of childhood maltreatment and their responses to infant emotional signals and offspring verbalizations for child and multi-informant reports. Thus, it may depend on the construct under evaluation whether single- or multi-informant methods produce different results. A better understanding of reporter effects also has practical implications. When deciding about interventions in case of maltreatment, such as out-of-home placements, professionals often take into account both parent and child reports in their decision making (Gilbert et al., 2009). Understanding the implications of parent-child convergence and divergence may support professionals in making more informed decisions.

Moreover, contrary to the majority of studies about child maltreatment that solely included mothers (e.g., Wilson et al., 2008), we included a relatively large number of fathers in our study. Hence, findings of the present dissertation can be generalized to *all* parents. While gender was included as a covariate in all of our studies, and gender effects were explored when examining child maltreatment in the context of the family, studying gender effects was not the main focus of our research. Because fathers' involvement in child care has continuously increased in many western countries the past few decades (Jones & Mosher, 2013; World Health Organization (2007), it would be of interest to examine the role of fathers in the etiology and sequelae of child maltreatment in more detail.

Finally, although we used a multidimensional multi-method investigation of child maltreatment to gain a more comprehensive understanding of child maltreatment, participants of the current study were evaluated at one point in time. Longitudinal research is needed to capture the dynamic nature of child maltreatment even better. Future research should consider to concurrently examine cognitive-affective, psychological, behavioral, and family processes and their interplay at various developmental periods to provide an integrative conceptualization of child maltreatment over the developmental course. In doing so, both protective and risk factors for a healthy development in the presence of significant adversity can be identified.

Concluding remarks

In the current series of studies, a multidimensional approach was used to investigate the antecedents and consequences of child maltreatment. Consistently different conclusions were reached for abuse and neglect. First, we found evidence of intergenerational transmission of abuse using both single- and multi-informant approaches. However, intergenerational transmission of neglect was only found when the same individual reported on experienced and perpetrated neglect, suggesting that the evidence of transmission of neglect is driven by dependency of the perceptions of one person. In addition, abuse (both experienced and perpetrated) was found to be more strongly associated with parents' behavioral responses, whereas experienced neglect was more strongly associated with parents' autonomic responses. These findings highlight the need to distinguish between abuse and neglect, both in research and in practice. Furthermore, we aimed to provide

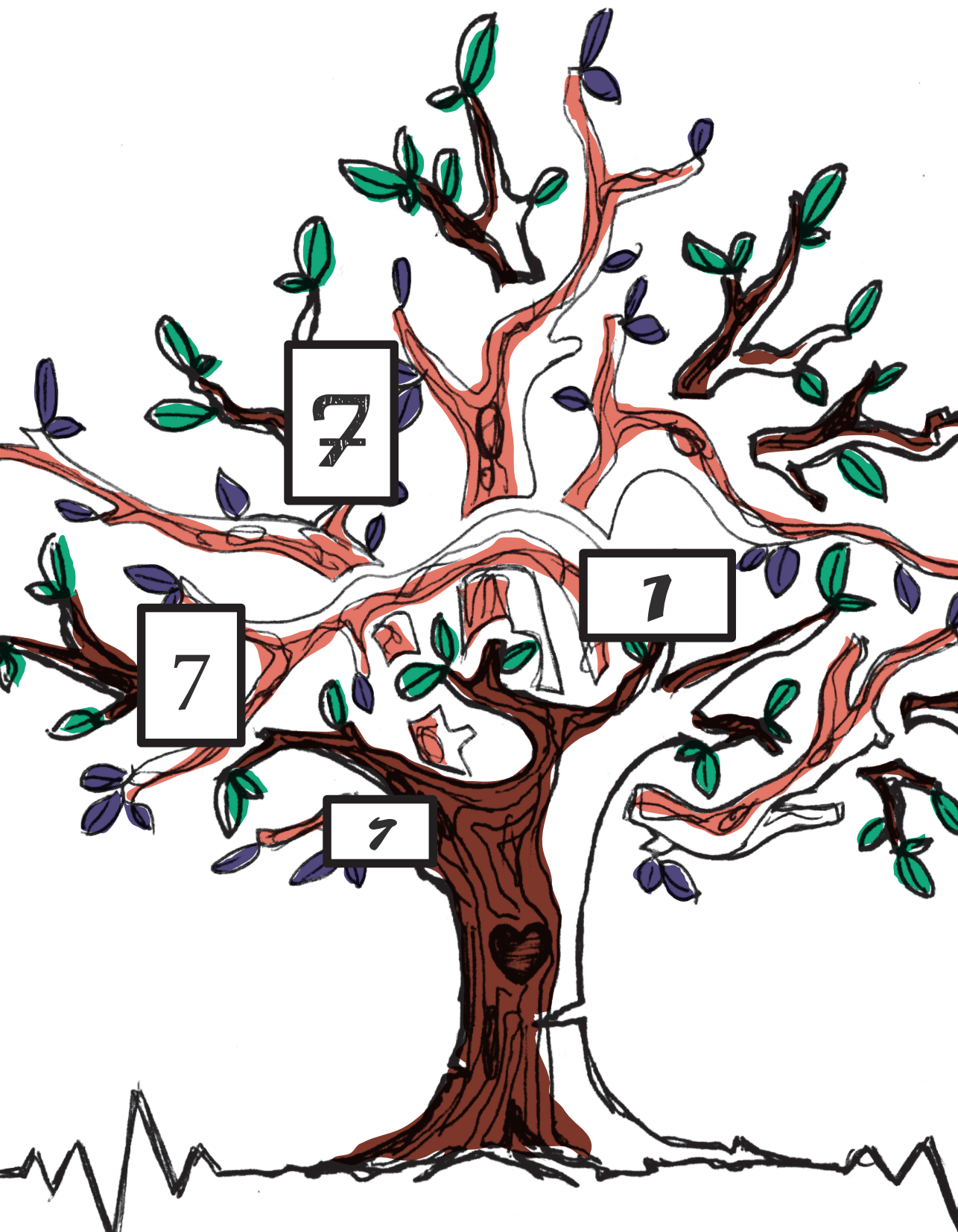
a more integrative conceptualization of the antecedents and consequences of child maltreatment by concurrently examining processes at different levels of functioning (i.e., cognitive-affective, physiological, behavioral and family). Interestingly, for most part, parents' behavioral and autonomic systems were not interrelated. Continued efforts are needed in order to understand how parents' biology shapes their parenting behavior. For example, future research on child maltreatment could consider assessing multiple physiological systems and their interplay with behavior at varying developmental periods. Although we do acknowledge that including all levels of analysis within the same research design is not easy, interdisciplinary research incorporating neuroscience and developmental psychopathology is on the rise, facilitating a multidimensional developmental approach. Such an approach might not only be crucial for continued progress to take place in understanding the antecedents and consequences of child maltreatment, but also informs efforts to develop interventions that promote parental functioning.

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Chapter 7

Supplementary material



Supplementary material Chapter 2

Table S2.1. Occurrence of self-reported experienced emotional and physical abuse and neglect.^{a, b}

	Never	Once	More than once
Abuse	14 (4%)	11 (3%)	310 (93%)
Physical Abuse	72 (21%)	41 (12%)	222 (66%)
Emotional Abuse	26 (8%)	17 (5%)	292 (87%)
Neglect	12 (4%)	3 (1%)	320 (96%)
Physical Neglect	215 (64%)	24 (7%)	96 (29%)
Emotional Neglect ^c	12 (4%)	3 (1%)	320 (96%)

^a Children reported about mother and father.

^b Occurrences are based on items describing concrete parenting behaviors rather than the overall scales.

^c Note that four of the emotional neglect items were recoded. This means that participants who 'never' experienced emotional neglect, reported that they '(almost) always' felt emotionally supported.

Table S2.2. Occurrence of self-reported perpetrated emotional and physical abuse and neglect^a

	Never	Once	More than once
Abuse	12 (5%)	19 (8%)	219 (88%)
Physical Abuse	19 (8%)	34 (14%)	197 (79%)
Emotional Abuse	61 (25%)	43 (17%)	146 (58%)
Neglect	27 (11%)	31 (12%)	192 (77%)
Physical Neglect	172 (69%)	57 (23%)	21 (8%)
Emotional Neglect ^b	31 (12%)	34 (14%)	185 (74%)

^a Parents reported about up to three children. As the number of children varied across parents, occurrence was based on the highest child score.

^b Note that four of the emotional neglect items were recoded. This means that participants who 'never' experienced emotional neglect, reported that they '(almost) always' felt emotionally supported.

Table S2.3. Summary of Correlations, Means, and Standard Deviations of non-imputed observed variables

	Mean (SD)	Exp. Abuse CR	Exp. Abuse FR	Exp. Abuse MR	Perp. Abuse PR	Perp. Abuse CR	Exp. Neglect CR	Exp. Neglect FR	Exp. Neglect MR	Perp. Neglect PR	Perp. Neglect CR	Gender G2	Age G2
Exp. Abuse CR	1.82 (1.23)												
Exp. Abuse FR	1.36 (0.82)	.37**											
Exp. Abuse MR	1.44 (0.98)	.34**	.31**										
Perp. Abuse PR	1.58 (0.92)	.49**	.21	.25*									
Perp. Abuse CR	1.49 (1.01)	.28**	-.04	.03	.33**								
Exp. Neglect CR	2.58 (1.36)	.53**	.26**	.12	.24**	.17*							
Exp. Neglect FR	1.56 (0.93)	.06	.18*	.20*	-.10	-.13	.25**						
Exp. Neglect MR	1.33 (0.91)	.07	.21*	.35**	-.14	-.27	.11	.38**					
Perp. Neglect PR	1.62 (1.01)	.11	-.09	.03	.32**	.09	.29**	.27	-.01				
Perp. Neglect CR	2.19 (1.08)	.06	.08	-.02	.20**	.29**	-.02	-.02	-.06	.35**			
Gender G2 (% male)	43.9%	.00	-.16*	.04	-.04	.01	.03	.04	-.03	-.21**	-.15		
Age G2	33.46 (16.90)	.28**	-.14	.05-	.10	.08	.33**	-.06	.00	.25**	-.08	.01	
Household SES	0.19 (0.68)	-.03	-.09	.02	-.09	.01	-.09	.01	.17*	.19**	-.12	.01	.06

Note. CR = Child report; FR = Father report; MR = Mother report; PR = Parent report; Exp. = maltreatment experienced by G2; Perp. = maltreatment perpetrated by G2; Sex: male coded as 1, and female coded as 2. Exp. Abuse FR indicate the abuse that was experienced by the child, but was perpetrated and reported by the father. The same applies to Exp. Abuse MR. * $p < .05$; ** $p < .01$

Informant agreement

We examined the absolute agreement between the different informants for experienced abuse and neglect separately by calculating the intraclass correlation coefficients (ICC (3,k), single measures, absolute agreement, see Shrout & Fleiss, 1979). ICC (3,k) was employed with experienced abuse and neglect of each target (i.e., the child) being rated by three reporters (i.e., mother, father, child). Intraclass correlations were computed for father-child, mother-child, and father-mother pairs separately. ICC's were averaged across imputed data sets. As shown in Table S2.4, agreement among all informants was modest (ICCs $\leq .35$). The lowest level of agreement was found between MR and CR for neglect, whereas the highest level of agreement was found between father and mother report for neglect, implying parents reported relatively similar regarding neglectful behavior.

Table S2.4. Concordance between different informants of abuse and neglect

	ICC (3,k)		
	Father-child	Mother-child	Father-mother
Abuse	0.32	0.28	0.31
Neglect	0.14	0.05	0.35

Supplementary material Chapter 3

Comparison of included and excluded participants

Of the 190 participants eligible for the task, 30 participants did not complete the infant vocalizations paradigm and were excluded. Included participants had a significantly lower SES than excluded participants, $t(185) = -2.50$, $p = .01$, and reported significantly more experienced abuse and neglect than excluded participants, $t(55.90) = 3.12$, $p < .01$ and $t(188) = 2.59$, $p = .01$ respectively. Included and excluded participants did not differ on ethnicity, age or gender ($ps > .45$).

A total of 160 participants were included in the perception analysis, 147 participants in the analysis on behavioral responses, and 135 participants in the analyses on autonomic responses. Included and excluded participants for the analysis on behavioral responses did not differ on any of the background variables (ethnicity, socio-economic status (SES), age, gender) or experienced abuse and neglect ($ps > .08$). Participants excluded from the analysis on autonomic responses were older ($t(158) = 4.74$, $p < .001$) and had a higher SES ($t(158) = 3.26$, $p < .01$).

Table S3.1. PEP and self-reported experienced abuse and neglect

	Model 1	Model 2	Model 3	Model 4
Fixed effects	Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept	113.90 (2.01)***	109.41(3.09)***	119.89 (6.77)***	114.34 (9.19)***
Age		-0.04(0.21)	-0.05 (0.21)	0.01 (0.22)
Gender		7.64 (4.05)	6.81 (4.04)	7.73 (4.02)
Order			-6.43 (3.96)	-7.87 (3.98)
No sound - Cry			-1.43 (0.51) **	-1.43 (0.51)**
Laughter - Cry			-0.60 (0.51)	-0.61 (0.51)
Exp ^a Abuse				2.37 (1.78)
Exp Neglect				-2.21 (1.67)
Variance components				
Stimulus level Int ^b	17.72 (1.56)	17.72 (1.53)	17.22 (1.48)	17.22 (1.50)
Person level Int	538.24 (66.58)	523.50 (64.54)	507.15 (63.01)	503.55 (63.10)
Deviance	2912.26	2912.70	2908.18	2909.60

Note. Gender coded 0 = male, 1 = female. Order coded 0 = Laughter, 1 = Cry. Episode is dummy-coded in two dummies (No sound, Laughter) with Cry as the reference category. Because of extremely large confidence intervals for the variance at the family level, this level was removed from the analysis. Excluding variance at the family level did not influence the results. ^aExp = experienced, ^bInt = intercept. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table S3.2. Mean (SD) and Pearson correlations between all predictor and outcome variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1. Age	45.83 (9.97)																
2. Gender (% male)	.13	42															
3. Perception laughter	.28***	5.49 (2.45)	-.04														
4. Perception cry	.13	10.04 (3.39)	.06	.26**													
5. Handgrip no sound	.04	0.64 (0.15)	.04	-.00	.13												
6. Handgrip laughter	-.05	0.61 (0.16)	-.05	-.03	.08	.86***											
7. Handgrip cry	-.02	0.61 (0.16)	-.02	.06	.77***	.81***											
8. HR no sound	-.13	67.27 (10.32)	.16	.09	-.02	.02	-.02										
9. HR laughter	-.16	68.17 (10.23)	.12	.11	-.04	-.02	.03	-.01	.98***								
10. HR cry	-.13	67.38 (10.20)	.16	.11	-.02	-.01	.02	-.01	.98***	.98***							
11. PEP no sound	-.01	113.10 (23.56)	.18*	.04	.04	.04	-.01	.00	-.18*	-.16	-.16						
12. PEP laughter	-.04	113.90 (23.77)	-.04	.16	-.00	.01	.04	-.00	.02	-.16	-.14	.97***					
13. PEP cry	-.06	114.29 (23.86)	-.06	.16*	.04	.01	.05	.00	.02	-.16	-.13	.97***	.97***				
14. RSA no sound	-.42***	16.36 (2.71)	.19*	-.12	-.08	.19*	.22*	.21*	-.44***	-.44***	-.45***	.07	.10	.09			
15. RSA laughter	-.40***	15.65 (2.73)	.23**	-.08	-.09	.12	.14	.17	-.46***	-.46***	-.47***	.14	.17	.16	.86***		
16. RSA cry	-.44***	15.95 (2.88)	.29**	-.12	-.06	.14	.14	.15	-.39***	-.39***	-.41***	.16	.17	.17	.88***	.88***	
17. Exp abuse	.21**	2.09 (1.20)	-.00	.17*	.06	-.07	-.05	.01	.04	.06	.04	.05	.05	.07	-.11	-.02	-.07
18. Exp neglect	.45***	2.84 (1.33)	-.01	.12	.12	-.05	-.07	.06	.11	.10	.12	-.12	-.14	-.10	-.24***	-.24***	.42***

Note. Gender coded 0 = male, 1 = female. Perceptions of laughter and crying represent negative perceptions. Values for RSA, experienced abuse and experienced neglect were log-transformed and multiplied by 10 to scale up the variance. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table S3.3. Hierarchical multiple regression analyses predicting resting HR, PEP, RSA from experienced abuse and neglect

Predictor	Autonomic measures					
	HR		PEP		RSA	
	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	0.15**		0.02		0.44***	
Control variables ^a						
Step 2	0.06*		0.02		0.02	
Experienced abuse		0.01 (0.81)		0.14 (2.07)		-0.02 (0.18)
Experienced neglect		0.26 (0.79)**		-0.08 (2.04)		-0.15 (0.18)

Note. Standard errors are in parentheses. Gender coded 0 = male, 1 = female. Values for experienced abuse and experienced neglect were log-transformed. ^aControl variables included gender, age, and significant lifestyle and disease factors: alcohol and exercise for HR, exercise and respiration rate for RSA. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table S3.4. Hierarchical multiple regression analyses predicting perceptions of cry and laughter sounds from experienced abuse and neglect

Predictor	Perceptions			
	Laughter		Cry	
	ΔR^2	β	ΔR^2	β
Step 1	0.09**		0.08**	
Age		0.26 (0.02)**		0.12 (0.03)
Gender		-0.03 (0.37)		0.06 (0.53)
Order		-0.12 (0.36)		-0.26 (0.52)**
Step 2	0.02		0.02	
Experienced abuse		0.15 (0.17)		0.14 (0.25)
Experienced neglect		-0.04 (0.17)		-0.01 (0.25)

Note. Standard errors are in parentheses Gender coded 0 = male, 1 = female. Order coded 0 = Laughter, 1 = Cry. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table S3.5. RSA during infant sounds and experienced abuse and neglect

	Model 1	Model 2	Model 3	Model 4
Fixed effects	Coef (se)	Coef (se)	Coef (se)	Coef (se)
Intercept	15.98 (0.23)***	19.78 (0.80)***	19.46 (1.03)***	19.43 (1.04)***
Age		-0.13 (0.02)***	-0.13 (0.02)***	-0.11 (0.02)***
Gender		1.21 (0.37)**	1.19 (0.37)**	1.16 (0.38)**
Respiration rate		-0.32 (0.04)***	-0.29 (0.04)***	-0.29 (0.04)***
Physical exercise		0.54 (0.21)*	0.55 (0.22)*	0.56 (0.22)*
Order			-0.13 (0.37)	-0.14 (0.38)
Baseline - Cry			0.07 (0.12)	0.07 (0.12)
Laughter - Cry			-0.16 (0.12)	-0.16 (0.12)
Experienced Abuse				-0.01 (1.00)
Experienced Neglect				-0.24 (0.19)
Variance components				
Stimulus level Intercept	1.08 (0.10)	0.90 (0.08)	0.89 (0.08)	0.88 (0.07)
Person level Intercept	6.60 (0.87)	4.14 (0.57)	4.16 (0.56)	4.08 (0.54)
Deviance	1571.73	1466.01	1468.50	1470.38

Note. Standard errors are in parentheses. Gender coded 0 = male, 1 = female. Order coded 0 = Laughter, 1 = Cry. Episode is dummy-coded in two dummies (No sound, Laughter) with Cry as the reference category.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Supplementary material Chapter 5

Family cohesion

Family cohesion was observed during a playful tower building game (Jenga). Nuclear families were asked to collaborate in building a tower as high as possible with the provided wooden parts. They were instructed to work on it for 10 minutes, and to start over should the tower collapse. The tower building was filmed and no other people were in the room. The task was coded with the System for Coding Interactions and Family Functioning (SCIFF; Lindahl, & Malik, 2000). The SCIFF was designed to code family problem discussions but has also been used successfully to code family play interactions (e.g., Shigeto, Mangelsdorf, & Brown, 2014). Although the SCIFF includes multiple scales of family functioning, we focused on the scale Cohesiveness in order to capture how families interact as a whole. Cohesiveness represents the sense of unity, togetherness, and closeness within a family. The degree of cohesiveness in a family represents the extent to which family members are affectionate, respectful, and warm to each other. Cohesiveness was rated on a 5-point scale (1 = very low, 2 = low, 3 = moderate, 4 = high, and 5 = very high). Very highly cohesive families demonstrate a sense of togetherness and closeness. These families show mutual appreciation as they work together toward a common goal.

The tower building task was coded by the first author and a trained research assistant (who did not code the dyadic parent-child interactions, see below). Coders were blind to maltreatment history and maltreatment perpetration. Extensive training in using the coding system was developed by the first, second and last author of the manuscript and was given by the first author. After training, 30 videos were coded to assess reliability. Interrater reliability (ICC; single measures, absolute agreement) between the two observers was .73, indicating good reliability. Subsequently videos were coded individually, and during biweekly meetings videos were discussed to minimize observer drift. Observations of family cohesion were missing for 12 nuclear families due to technical problems and for 6 families because parents and offspring could not attend on the same day.

Table S5.1. Descriptive statistics and correlation of non-imputed observed variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Individual level																
1. P to O Comm	-															
2. O to P Comm	.57**	-														
3. Dyadic A. D.	.30**	-.52**	-													
4. Abuse	-.24**	-.21**	-.07	-												
5. Neglect	-.06	-.13*	.05	.29**	-											
6. Problem	.04	-.18**	.09	.03	.06	-										
7. Supp Role	.03	-.11*	.07	-.04	.04	.27**	-									
8. Age P	-.07	.05	-.04	.11*	.09	-.23**	-.72**	-								
9. Age O	-.08	.09	-.08	.14**	.06	-.26**	-.76**	.93**	--							
10. Gender P	.11*	-.08	.18**	.09	-.13*	.02	-.06	.00	.07	-						
11. Gender O	.15**	.14*	.01	-.06	.04	-.02	-.18*	.10*	.12*	.02	-					
12. SES P	.12*	.06	.01	-.10	-.00	.15**	.26**	-.28**	-.37**	-.09	.05	-				
13. SES O	.08	.11	-.07	.01	.01	-.02	-.08	.16**	.09	-.02	.08	.52**	-			
Family level																
14. Cohesion	.15**	.34**	-.19**	-.05	.06	-.19**	-.19**	.15**	.22**	-.03	.20**	.11	.07	-		
15. Abuse	-.15**	-.18**	-.00	.79**	.23**	-.02	-.06	.14**	-.09	.07	-.09	-.13*	.01	-.07	-	
16. Neglect	.01	-.08	.05	.24**	.76**	.04	.03	.11**	.09	-.02	.00	-.01	.01	.09	-.30**	-
17. Size	-.00	.07	-.06	-.06	.01	-.13*	.11*	-.08	-.08	-.11*	-.10	.18**	-.01	-.10	-.09	-.01
Means	5.47	6.17	0.45	1.39	1.73	0.90	0.60	53.87	24.55	0.55	0.57	-0.05	0.20	3.14	1.39	1.73
SDs	1.38	1.62	1.29	0.81	0.87	0.30	0.49	13.34	13.91	0.50	0.50	0.81	0.66	1.20	0.64	0.66

Note. P = Parent, O = Offspring, Comm = Communication, A = Affective, D = Dissimilarity, Supp. = Supportive. Values for abuse and neglect were log-transformed. Variables 14 and 15 represent abuse and neglect scores aggregated at the nuclear family level. Gender: 0 = male, 1 = female. * $p < .05$; ** $p < .01$.

Table S5.2. Correlations between pooled study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Individual level																
1. P to O Comm	-															
2. O to P Comm	.57**	-														
3. Dyadic A. D.	.30**	-.52**	-													
4. Abuse	-.24**	-.22**	-.06	-												
5. Neglect	-.06	-.13*	.06	.29**	-											
6. Problem	.04	-.17**	.08	.02	.05	-										
7. Supp Role	.04	-.09	.05	-.06	-.00	.27**	-									
8. Age P	-.08	.04	-.03	.11*	.09	-.24**	-.71**	-								
9. Age O	-.09	.07	-.07	.14**	.06	-.26**	-.75**	.93**	-							
10. Gender P	.10	-.07	.17**	.09	-.13*	.03	-.05	.00	.07	-						
11. Gender O	.15**	.12*	.01	-.06	.04	-.01	-.16**	.10*	.12*	.02	-					
12. SES P	.13*	.07	-.01	-.10	-.00	.17**	.30**	-.28**	-.37**	-.09	.05	-				
13. SES O	.08	.10	-.07	.01	.01	-.02	-.06	.16**	.09	-.02	.08	.53**	-			
Family level																
14. Cohesion	.16**	.33**	-.17**	-.05	.06	-.17**	-.15**	.10	.17**	-.01	-.19**	.11	.07	-		
15. Abuse	-.17**	-.20**	.01	.79**	.23**	-.03	-.09	.14**	.17**	.07	-.09	-.13*	.01	-.08	-	
16. Neglect	.00	-.08	.05	.24**	.76**	.02	-.01	.11**	.09	-.02	.00	-.01	.01	.08	.30**	-
17. Family size	.01	.08	-.06	-.06	.01	-.11*	.13*	-.08	-.11	-.11*	-.10	.18**	-.01	-.12*	-.09	-.01

Note. P = Parent, O = Offspring, Comm = Communication, A = Affective, D = Dissimilarity, Supp. = Supportive. Values for abuse and neglect were log-transformed. Variables 14 and 15 represent abuse and neglect scores aggregated at the nuclear family level. Gender: 0 = male, 1 = female. * $p < .05$; ** $p < .01$.

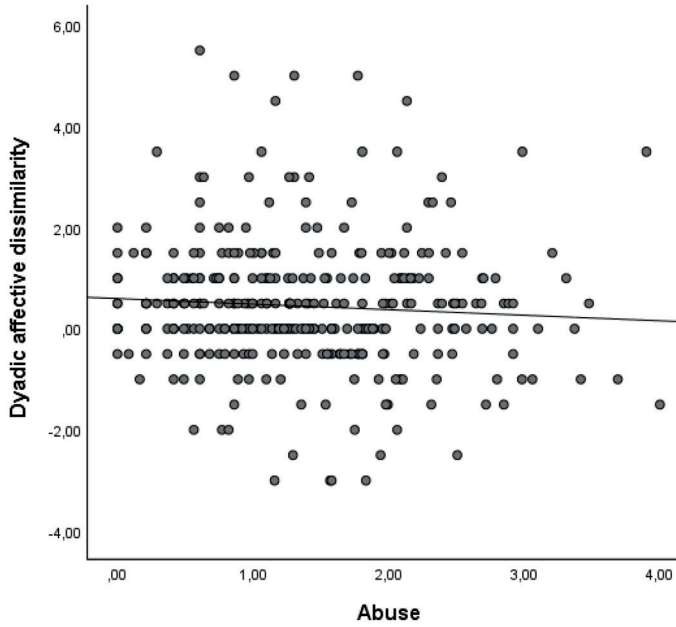


Figure S5.1

Association between abuse and dyadic affective dissimilarity

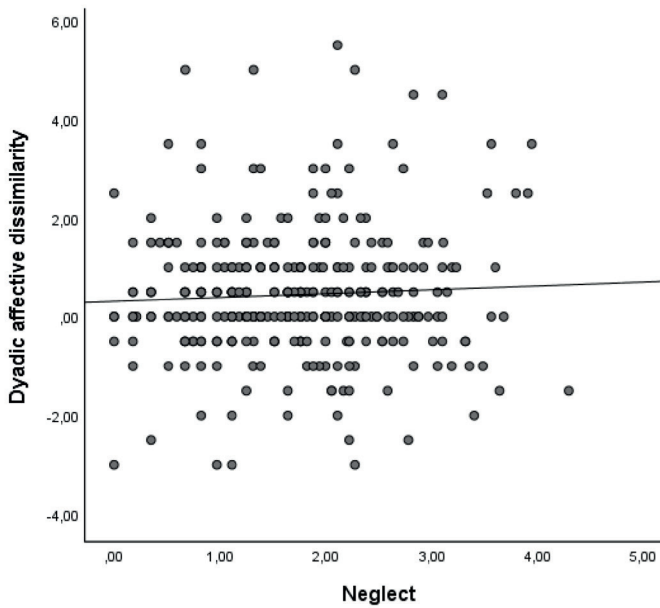
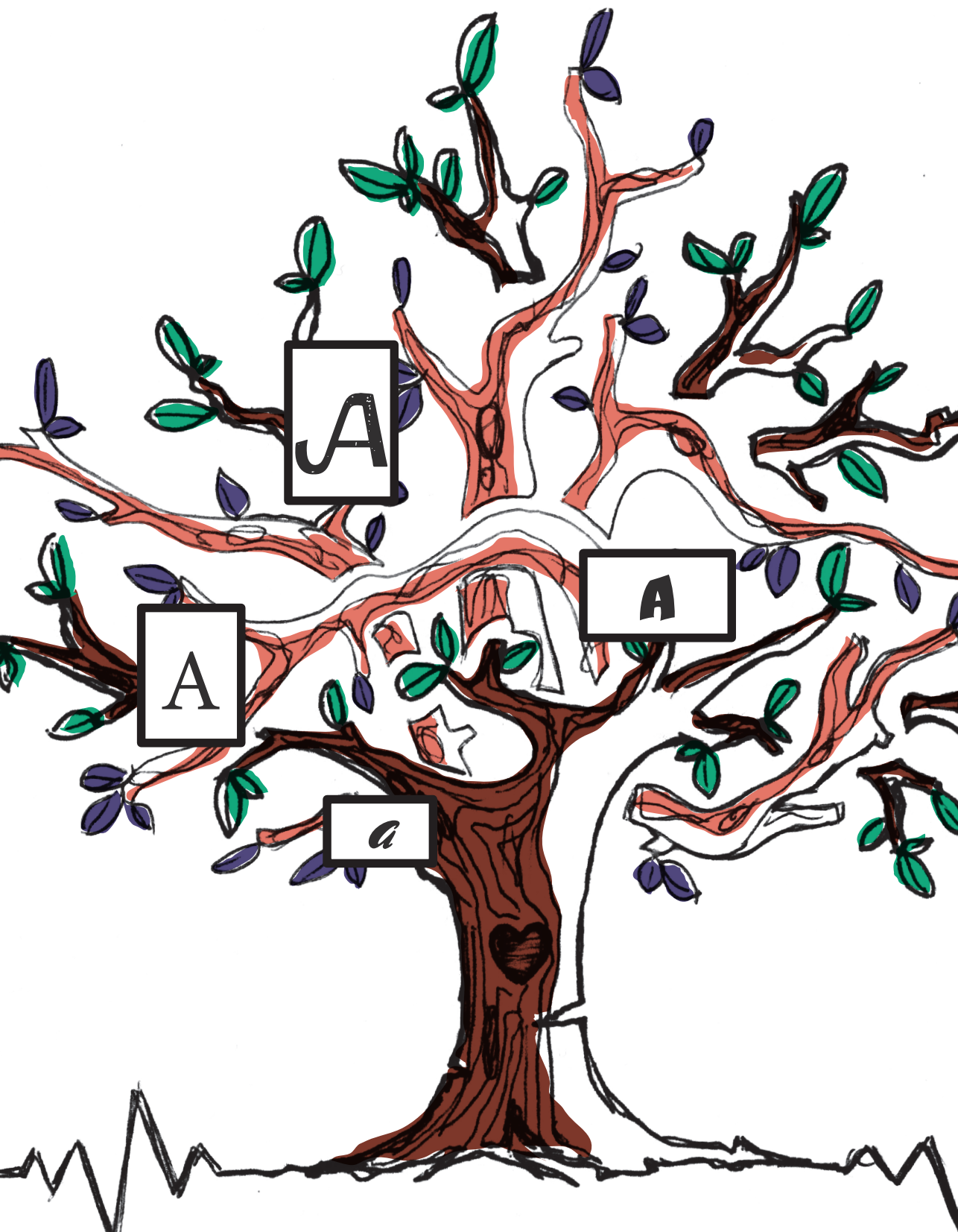


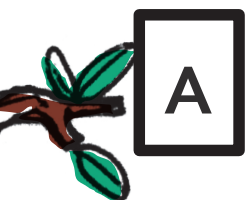
Figure S5.2

Association between neglect and dyadic affective dissimilarity

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Appendices



Nederlandse samenvatting (Summary in Dutch)

In 2017 waren in Nederland tussen de 90.000 en 127.000 kinderen van 0 tot 18 jaar slachtoffer van een vorm van kindermishandeling (Alink et al., 2018). Dat is ongeveer 3 procent van alle kinderen in Nederland. Deze cijfers zijn gebaseerd op rapportages van professionals. Aangezien professionals niet alle gevallen van kindermishandeling signaleren, moet deze 3 procent als ondergrens beschouwd worden. Kindermishandeling wordt in de Jeugdwet (Artikel 1.1, 2014) gedefinieerd als “...elke vorm van voor een minderjarige bedreigende of gewelddadige interactie van fysieke, psychische of seksuele aard, die de ouders of andere personen ten opzichte van wie de minderjarige in een relatie van afhankelijkheid of van onvrijheid staat, actief of passief opdringen, waardoor ernstige schade wordt berokkend of dreigt te worden berokkend aan de minderjarige in de vorm van fysiek of psychisch letsel” (Jeugdwet, Artikel 1.1, 2014). Onder deze definitie vallen zowel fysieke en emotionele mishandeling (actieve vormen van mishandeling) als fysieke en emotionele verwaarlozing (passieve vormen van mishandeling).

Zowel in Nederland als in andere landen lijkt het aantal slachtoffers van kindermishandeling niet te zijn afgenomen de afgelopen jaren (Alink et al., 2018; Finkelhor, Turner, Shattuck, & Hamby, 2015; Gilbert et al., 2012). Dit heeft mogelijk te maken met de complexiteit van het probleem. Zowel de oorzaken als de gevolgen van kindermishandeling zijn divers en daardoor soms moeilijk oplosbaar. Slachtoffers van kindermishandeling hebben vaker last van depressies en angststoornissen, ervaren vaker problemen in de stress- en emotieregulatie en hebben als ouder een grotere kans om zelf hun kinderen te mishandelen (Norman, Byambaa, Butchart, Scott, & Vos, 2012; Madigan et al., 2019). Risicofactoren voor kindermishandeling zijn gevonden op verschillende niveaus, waaronder het niveau van de ouder, het kind en de familie. Voorbeelden van risicofactoren zijn: verhoogde stress reactiviteit van de ouder, externaliserend probleemgedrag van het kind en een lage gezinscohesie (Stith et al., 2009). Juist die rol van processen op meerdere niveaus (o.a., fysiologie, gedrag, familiecontext), die ook onderling interacteren, maakt dat de aard van kindermishandeling moeilijk te doorgronden is. Om de antecedenten en consequenties van kindermishandeling beter te begrijpen, is in dit proefschrift daarom gekozen voor een multidimensionale multi-methodische benadering binnen een multigenerationele familiestudie. Hierbij richtten we ons op aspecten binnen het individu (fysiologie, cognities, gedrag) en in de omgeving van het individu (gezin, familie in brede zin). Met meer inzicht in de rol van processen op verschillende niveaus kunnen wellicht interventies worden opgezet met als doel het vóórkomen van kindermishandeling te verminderen.

De 3-Generatie Ouderschapsstudie

Het huidige proefschrift is gebaseerd op een cross-sectioneel multigenerationeel familieonderzoek: De 3-Generatie Ouderschapsstudie (3G Parenting Study, zie ook Compier-

de Block et al., 2017). De 3-Generatie Ouderschapsstudie had als doel om meer inzicht te verkrijgen in het samenspel van methodologische, genetische en omgevingsfactoren in de intergenerationele overdracht van emotieregulatie en opvoedstijlen. Voor deze studie hebben we individuen geworven met een verhoogd risico op meegemaakte kindermishandeling. Potentiële deelnemers ontvingen een flyer met informatie over het onderzoek en werden vervolgens telefonisch benaderd. Na instemming tot deelname aan het onderzoek en het geven van toestemming om familieleden te benaderen, werden ook familieleden van deze beoogde deelnemer en hun partner uitgenodigd om deel te nemen (ouders, kinderen, broers en zussen (en hun partners), nichten en neven). Figuur 1.1 toont een stamboom van deelnemers uit drie generaties rond de beoogde deelnemer (F1, F2 en F3) die zijn uitgenodigd. Gezinsleden moesten minstens 7,5 jaar oud zijn om deel te kunnen nemen. Gezinnen konden deelnemen als ten minste twee eerstegraads familieleden van twee generaties ermee instemden om mee te doen met het onderzoek. De deelnemers werden vooraf geïnformeerd over het algemene doel van het onderzoek (dat werd geformuleerd als de rol van genen en opvoeding in de intergenerationele overdracht van stress-gerelateerde kenmerken) en over de procedure van het onderzoek. Gegevens werden verzameld tussen maart 2013 en mei 2016.

In totaal hebben we 395 participanten geïncludeerd afkomstig uit 63 verschillende families. De jongst deelnemende participant was 7,5 jaar oud en de oudste deelnemende participant was 88 jaar oud. Zowel vaders als moeders participeerden in de 3-Generatie Ouderschapsstudie.

Uitkomsten van het onderzoek

Het meten van (de intergenerationele overdracht van) kindermishandeling

Een opvallend gevolg van het meemaken van kindermishandeling is het verhoogde risico om zelf pleger te worden van kindermishandeling. Deze zogeheten “intergenerationele overdracht” is een veelbesproken onderwerp binnen het onderzoeksdomein van kindermishandeling en is regelmatig onderzocht de afgelopen jaren (Madigan et al., 2019; Thornberry, Knight, & Lovegrove, 2012). Naar schatting wordt 7 tot 40% van de mishandelde kinderen een mishandelende ouder (Dixon et al., 2005; Egeland, Jacobvitz & Sroufe, 1988; Pears & Capaldi, 2001). Deze percentages lopen waarschijnlijk zo sterk uiteen door variatie in onderzoeksdesign (retrospectief vs. prospectief), populatie en steekproef (risico sample vs. representatief sample), en de informant die over kindermishandeling rapporteerde (professional vs. zelfrapportage van ouder of kind). Een methodologisch aspect van de intergenerationele overdracht van kindermishandeling dat tot op heden weinig aandacht heeft gekregen, is het gebruik van enkele versus meerdere informanten om kindermishandeling in kaart te brengen. De meerderheid van de studies heeft gebruik gemaakt van één enkele informant (vaak alleen de ouder of het kind) om meegemaakte en

gepleegde kindermishandeling te meten (Thornberry, et al., 2012). Ouders kunnen echter minder gepleegde mishandeling rapporteren dan daadwerkelijk heeft plaatsgevonden vanwege het stigma dat gepaard gaat met kindermishandeling of uit angst voor juridische consequenties (Knight, Runyan, Dubowitz, Brandford, & Kotch, 2000). Kinderen kunnen daarnaast minder meegemaakte mishandeling rapporteren dan daadwerkelijk heeft plaatsgevonden vanwege loyaliteit naar ouders of uit angst om gestraft te worden (Della Femina, Yeager, & Lewis, 1990; Jouriles, Mehta, McDonald, & Francis, 1997). Tot slot kunnen zowel ouder- als kind-rapportage vertekend zijn door vervormde herinneringen (Edwards et al., 2001) en door de subjectieve beleving van bepaalde gebeurtenissen (Smith, Ireland, Thornberry, & Elwyn, 2008). De consequenties van dergelijke vertekeningen kunnen gereduceerd worden door gebruik te maken van een multi-informante benadering om kindermishandeling in kaart te brengen (Kraemer et al., 2003; Thornberry, et al., 2012).

In Hoofdstuk 2 van dit proefschrift gebruikten we daarom een multi-informante benadering om de intergenerationale overdracht van kindermishandeling te onderzoeken. Hierbij onderscheidden we mishandeling (actieve vorm) van verwaarlozing (passieve vorm van mishandeling). Door middel van Principale Component Analyse (PCA) combineerden we de scores van moeder, vader en kind over de mishandeling en verwaarlozing die het kind had meegemaakt. Om de resultaten van deze multi-informante benadering te vergelijken met meer conventionele methodes onderzochten we de intergenerationale overdracht van mishandeling en verwaarlozing ook op basis van het perspectief van één informant en op basis van de perspectieven van verschillende informanten uit elke generatie. We vonden intergenerationale overdracht van mishandeling onafhankelijk van de methode die we toepasten, dus zowel met de multi-informante aanpak als met de twee meer conventionele benaderingen. Intergenerationele overdracht van verwaarlozing vonden we echter alleen op basis van de rapportage van één enkele informant. Aangezien het includeren van meerdere perspectieven de betrouwbaarheid en validiteit van de bevindingen verhoogt door vermindering van willekeurige en systematische bias (Thornberry et al., 2012), rijst hierbij de vraag of de overdracht van verwaarlozing een valide bevinding is. De bevindingen suggereren dat de transmissie van verwaarlozing gestuurd wordt door het perspectief van één informant. Het gebruik van een meer nauwgezette methode om kindermishandeling te meten lijkt dus van invloed te zijn op de inschatting van de overdracht van verwaarlozing, maar niet op de inschatting van de overdracht van mishandeling. Deze bevinding lijkt te verschillen van de bevinding van de meta-analyse van Madigan en collega's (2019) dat studies met een hogere methodologische kwaliteit een minder sterke overdracht van mishandeling vonden, maar niet van verwaarlozing. Wij onderzochten echter slechts één methodologisch aspect, namelijk het gebruik van een enkele- versus een multi-informant benadering. Dit aspect kan vooral relevant zijn bij het vergelijken van de kans op de intergenerationale overdracht van mishandeling en verwaarlozing. Mishandeling beschrijft de aanwezigheid

van gedrag, terwijl verwaarlozing de afwezigheid van gedrag beschrijft. Het is mogelijk om de aanwezigheid van gedrag te rapporteren zonder de adequaatheid ervan te beoordelen (bijv. Mijn moeder/vader schreeuwde tegen mij), terwijl het rapporteren van de afwezigheid van gedrag een beoordeling vereist of het gedrag aanwezig had moeten zijn (bijv. Mijn vader/moeder bracht mij niet naar een dokter of ziekenhuis als dat nodig was). Doordat verwaarlozing minder goed objectief te meten is dan mishandeling, is er wellicht minder overeenstemming tussen ouder en kind, wat vervolgens het combineren van hun rapportages bemoeilijkt. Hoewel verwaarlozing als vorm van kindermishandeling steeds meer aandacht krijgt in onderzoek, valt er nog veel winst te behalen op het gebied van het meten van verwaarlozing.

We willen wel benadrukken dat er geen perfect meetinstrument of perfecte methode bestaat waarbij alle vormen van mishandeling volledig en correct kunnen worden geïdentificeerd. Wetenschappelijke methoden zijn nooit geheel vrij van bias en bias is wellicht nog meer een probleem in een onderzoeksveld dat zo'n gevoelig fenomeen als kindermishandeling onderzoekt. De data-gedreven aanpak (PCA), die we gebruikten om rapportages van meerdere informanten te combineren, moet dan ook beschouwd worden als één van vele methoden die gebruikt kan worden om perspectieven van verschillende informanten te combineren. In onze data-gedreven benadering kreeg de rapportage van het kind bijvoorbeeld minder gewicht in het schatten van de aanwezigheid van kindermishandeling. In theorie lijkt er echter weinig reden om de rapportage van het kind minder gewicht te geven dan de rapportage van de ouders bij het inschatten van de aanwezigheid van kindermishandeling. Een theorie-gedreven benadering zou dan ook geschikter kunnen zijn dan een data-gedreven benadering om perspectieven van verschillende informanten te combineren bij onderzoeksvragen die ten grondslag liggen aan een hypothetisch proces. Bijvoorbeeld bij het bestuderen van het effect van mishandeling op het functioneren van het autonome zenuwstelsel.

Samenhang tussen vormen van kindermishandeling en gedrag en fysiologie

Naast methodologische aspecten van (de intergenerationele overdracht) van kindermishandeling waren we geïnteresseerd in mechanismen die een rol kunnen spelen in de overdracht van kindermishandeling. We onderzochten of factoren op meerdere niveaus (fysiologie, cognities, gedrag en gezinsomgeving) gerelateerd waren aan enerzijds het plegen van kindermishandeling en anderzijds het ervaren van kindermishandeling. Deze factoren bestudeerden we in drie verschillende opvoedingscontexten: 1) tijdens het luisteren naar het huilen en lachen van baby's, 2) tijdens een interactietaak waarbij ouders en kinderen een probleem bespreken, en 3) tijdens het spelen van een spel (Jenga) met het kerngezin. De eerste opvoedingscontext wordt beschreven in Hoofdstuk 3, waarin de fysiologische (autonome) en gedragsmatige (knijpkracht) reacties van ouders afkomstig op huil- en lachgeluiden van baby's werden onderzocht tijdens een gestandaardiseerd

babysignalen paradigma. Het paradigma bestond uit een 2 minuten durend geluid van een huilende baby en een 2 minuten durend geluid van een lachende baby. Om overmatig gebruik van knijpkracht in respons op deze babysignalen te meten, werd gebruik gemaakt van een krachtmeter (dynamometer). Daarnaast werd activiteit in rust en reactiviteit van het autonome zenuwstelsel (ANS) op deze babysignalen gemeten met behulp van elektrocardiografie (ECG) en impedantiecardiografie (ICG). In Hoofdstuk 4 en 5 wordt de interactietaak beschreven waarmee we de patronen van interacties tussen ouders en kinderen onderzochten. Ouder-kind paren werden gevraagd om 10 minuten een probleem te bespreken waar ze het over oneens zijn en te proberen om consensus te bereiken. Dit gebeurde in een aparte ruimte voorzien van een camera buiten het zicht van de onderzoekers. Tijdens de taak werden ECG- en ICG-signalen gemeten. De interacties werden achteraf gecodeerd aan de hand van een gevalideerd codeersysteem. De laatste opvoedingscontext, waarin het kerngezin een spel speelt, wordt beschreven in Hoofdstuk 5. Aan gezinnen werd gevraagd om gezamenlijk een zo hoog mogelijke Jenga toren te bouwen gedurende 10 minuten in een aparte kamer voorzien van een camera. Gezamenlijk wijzen de bevindingen, beschreven in deze hoofdstukken, dat subtypen van kindermishandeling verschillende samenhangen met gedragsmatige en fysiologische reacties. Ervaren en gepleegde mishandeling leek sterker samen te hangen met gedragsmatige reacties, terwijl het meemaken van verwaarlozing een betere voorspeller was van fysiologische reacties.

In Hoofdstuk 3 en 4 vonden we dat ouders die meer verwaarlozing tijdens hun kindertijd hadden ervaren een verhoogde autonome (re-)activiteit lieten zien in rust, tijdens het luisteren naar het lachen en huilen van baby's en tijdens het bespreken van conflicten met hun kinderen. Deze resultaten suggereren dat het ANS van ouders die verwaarlozing hebben meegemaakt *hyper(re)actief* is. Dit kan mogelijk verklaard worden doordat verwaarlozing, meer dan mishandeling, fungeert als een chronische stressfactor die een negatieve invloed heeft op het adequaat functioneren van het ANS (De Bellis, 2005). Verwaarlozing is nooit incidenteel: in de regel is er sprake van een patroon van inadequaat, verwaarlozend ouderschap dat een langere periode beslaat. Onderzoek heeft laten zien dat ouders vaker vervallen in verwaarlozend dan in mishandelend gedrag (Jonson-Reid, Drake, Chung, & Way, 2003; Lipien & Forthofer, 2004) en dat interventies gericht op de aanpak van kindermishandeling minder effectief zijn voor verwaarlozing dan voor mishandeling (MacMillan et al., 2005). Verwaarlozing wordt dan ook vaak beschouwd als een chronisch probleem dat moeilijk op te lossen is (Hildyard & Wolfe, 2002). Blootstelling aan chronische stressfactoren, zoals verwaarlozing, kan dysregulatie van fysiologische systemen tot gevolg hebben (Danese & McEwen, 2012) en dat kan zich uiten in ANS *hyper(re)activiteit*, zoals gevonden in de huidige studie. Opmerkelijk is dat vergelijkbare patronen van ANS *hyperreactiviteit* zijn aangetoond bij pleegkinderen die chronisch zijn verwaarloosd door hun biologische ouders (Oosterman, Schipper, Fisher,

Dozier & Schuengel, 2010) en bij kinderen die zijn geadopteerd uit instellingen, wat als een extreme vorm van verwaarlozing kan worden aangemerkt (Gunnar, Frenn, Wewerka, & Ryzin, 2009). ANS *hyper*reactiviteit is echter ook gevonden bij mensen die mishandeling hebben meegemaakt (Heim et al., 2000). De onderzoekers hadden in hun analyses echter niet gecontroleerd voor verwaarlozing, waardoor het mogelijk is dat gelijktijdige ervaringen van verwaarlozing ten grondslag liggen aan het verband tussen mishandeling en ANS reactiviteit. Ten slotte kan mishandeling ook een chronisch patroon volgen. Onze hypothese zou daarom nader onderzocht moeten worden in toekomstig onderzoek naar de unieke effecten van mishandeling en verwaarlozing dat ook de chroniciteit van het gedrag in ogenschouw neemt.

Resultaten van Hoofdstuk 3 lieten zien dat ouders die meer mishandeling tijdens hun kindertijd hadden meegemaakt minder warm en meer negatief waren tijdens het oplossen van conflicten met hun kinderen. In Hoofdstuk 4 vonden we vervolgens dat het vertonen van minder warm en meer negatief gedrag van ouders samenhangt met het plegen van meer mishandeling. Mishandeling zou sterker dan verwaarlozing samen kunnen hangen met gedragsmatige reacties door het aanleren van “onaangepaste” gedragspatronen. Volgens de sociale leertheorie (Bandura, 1973) leren individuen agressief gedrag te vertonen door agressief handelen van anderen te observeren en doordat ze positief worden bekrachtigd wanneer ze zelf agressief gedrag vertonen. Een dergelijke agressieve interpersoonlijke stijl kan zich vertalen in inadequate opvoedingsgedragingen die van generatie op generatie worden overgedragen. De sociale leertheorie zou echter in mindere mate van toepassing kunnen zijn op gedragingen die meer automatisch worden aangestuurd. In Hoofdstuk 3 vonden we bijvoorbeeld dat ouders die meer verwaarlozing hadden meegemaakt minder goed in staat waren hun knijpkracht te moduleren tijdens het luisteren naar babysignalen, maar meegemaakte mishandeling hing niet samen met hun knijpkracht. Het gebruik van knijpkracht kan worden beschouwd als een vorm van onbewust (automatisch) gedrag dat moeilijk te controleren of te modelleren is.

Tot slot kan de gevonden differentiële samenhang tussen mishandeling en verwaarlozing enerzijds en fysiologie en gedrag anderzijds betekenen dat ouders die mishandeling of verwaarlozing hebben ervaren in hun kindertijd eerder geneigd zijn om dezelfde vorm van mishandeling te plegen bij hun eigen kinderen. Dit wordt ook wel aangeduid als “homotypische intergenerationele continuïteit van mishandeling” (Madigan et al., 2019). We observeerden minder warm en meer negatief gedrag van ouders richting kinderen bij ouders die meer mishandeling hadden meegemaakt in hun kindertijd. Het vertonen van minder warm en meer negatief gedrag is kenmerkend voor ouders die mishandeling plegen (Borrego, Timmer, Urquiza, & Follette, 2004; Wilson, Rack, Shi en Norris, 2008). De overdracht van verwaarlozend gedrag is daarentegen moeilijker waar te nemen. Verwaarlozende ouders worden over het algemeen gekenmerkt door een gebrek aan betrokkenheid (Wilson, et al., 2008), dat lastig waarneembaar is tijdens een taak waarbij

ze 'gedwongen' worden om met hun kinderen te communiceren. In plaats daarvan kunnen deze ouders als reactie hierop meer stress ervaren, wat gedeeltelijk hun sterkere ANS reactie zou kunnen verklaren

Tot op heden zijn er geen andere studies bekend waarin de unieke effecten van mishandeling en verwaarlozing op fysiologische en gedragsmatige reacties gelijktijdig zijn onderzocht. Replicatie van de bevindingen beschreven in dit proefschrift is daarom nodig om de differentiële samenhang tussen mishandeling en verwaarlozing enerzijds en gedrag en fysiologie anderzijds te bevestigen en beter te begrijpen.

Kindermishandeling belicht op meerdere niveaus

In de reeks studies beschreven in dit proefschrift onderzochten we gelijktijdig factoren op fysiologisch, cognitief-affectief, gedrags- en familie niveau met als doel meer inzicht te krijgen in de complexe aard van kindermishandeling.

In Hoofdstuk 3 van dit proefschrift hebben we zowel percepties, ANS activiteit als het gebruik van knijpkracht van ouders gemeten tijdens het luisteren naar emotionele babysignalen. Hierboven beschreven we al dat ouders die meer verwaarlozing hadden meegemaakt in hun kindertijd een verhoogde ANS activiteit vertoonden tijdens het luisteren naar de babysignalen. Ook vonden we dat ouders die meer verwaarlozing hadden meegemaakt in hun kindertijd meer knijpkracht gebruikten terwijl ze luisterden naar het huilen van baby's, maar minder knijpkracht gebruikten terwijl ze luisterden naar het lachen van baby's. Opvallend is dat de percepties van ouders van deze babysignalen (o.a. het huilen is urgent, dit kind is ziek) niet samenhangen met hun ervaringen van mishandeling in de kindertijd. Deze resultaten suggereren dat het effect van meegemaakte mishandeling in de kindertijd op emotionele reacties op signalen van baby's zich voornamelijk afspeelt op een onbewust niveau. Ouders die verwaarlozing hebben meegemaakt in hun kindertijd zijn zich dus mogelijk niet bewust van de "afwijkende" fysiologische en gedragsmatige reacties die signalen van baby's bij hun oproepen.

De resultaten beschreven in Hoofdstuk 3 en 4 laten zien dat meegemaakte verwaarlozing in de kindertijd van ouders geassocieerd was met hun ANS regulatie. Fysiologische regulering wordt op haar beurt verondersteld ten grondslag te liggen aan ouderlijk gedrag (Bridges, 2008), maar onze resultaten ondersteunden dit slechts tot op zekere hoogte. We vonden geen samenhang tussen ANS reacties en gedragsmatige reacties op emotionele babysignalen. Daarnaast vonden we dat ANS activiteit alleen geassocieerd was met negatief gedrag, maar niet met warm of emotioneel ondersteunend gedrag van ouders: *minder* parasymphatische terugtrekking in de vorm van een hogere hartslagvariabiliteit (RSA) hing samen met het vertonen van meer negatief gedrag tijdens het bespreken van conflicten met kinderen. Deze bevinding was opmerkelijk, omdat algemeen wordt aangenomen dat *meer* parasymphatische terugtrekking samenhangt met een negatieve emotionele toestand. In de opvoedingscontext is inderdaad meer parasymphatische

terugtrekking gevonden bij ouders die meer negatief gedrag (namelijk het gebruik van harde discipline) vertoonden richting hun kinderen (Lorber & O'Leary, 2005). Daarentegen is meer parasympathische terugtrekking ook gevonden bij moeders die minder negatief gedrag vertonen, maar alleen als die moeders ook een hoge cortisolspiegel hadden, wat kenmerkend is voor acute of chronische stress (Mills-Koonce et al., 2005). Mogelijk zou meer parasympathische terugtrekking ouders kunnen beschermen tegen het vertonen van negatief gedrag wanneer zij chronische of acute stress ervaren. Deze hypothese konden we echter niet testen in onze studie, omdat we cortisol niet hebben gemeten tijdens de taak. We hebben ook onderzocht of ANS reactiviteit het verband tussen verwaarlozing en gedragsreacties medieerde. Uit de resultaten bleek dat dit niet het geval was, wat aangeeft dat ANS-activiteit het verband tussen meegemaakte kindermishandeling en ouderlijk gedrag niet verklaarde. Toekomstige studies zouden kunnen overwegen om zowel markers van het ANS als het hypothalamus-hypofyse-bijnier-as (HPA-as) systeem te gebruiken om meer inzicht te krijgen in de complexe samenhang tussen biologische systemen en opvoedgedrag.

Hoewel ons onderzoek naar de fysiologische correlaten van kindermishandeling beperkt was tot één fysiologisch systeem (het ANS), hebben we meerdere autonome markers onderzocht om ANS regulatie te verduidelijken. We bestudeerden zowel de sympathische (SNS) als de parasympathische (PNS) tak van het ANS. Over het algemeen wordt bij stress de sympathische tak geactiveerd terwijl parasympathische activiteit daalt (Viamontes & Nemeroff, 2009). De resultaten van Hoofdstuk 4 suggereren dat ervaringen van kindermishandeling zowel doorwerken in het functioneren van zowel het PNS als het SNS, zodat ouders die meer verwaarlozing hebben meegemaakt meer terugtrekking van PNS activiteit en meer activatie van SNS activiteit vertoonden in een stressvolle opvoedingscontext, wat duidt op autonome *hyper*reactiviteit. Vergelijkbare patronen van ANS-activiteit zijn gevonden bij volwassenen met een verleden van kindermishandeling tijdens blootstelling aan algemene psychosociale stressoren (Heim et al., 2000; Dale et al., 2009). Daarnaast maakten we ook een onderscheid tussen zogenaamde karaktertrekgerelateerde markers (gemeten tijdens rust) en situatie afhankelijke markers (gemeten tijdens een taak) van ANS activiteit. Ouders die meer verwaarlozing hadden meegemaakt in hun kindertijd, vertoonden naast hogere ANS reactiviteit ook een verhoogde ANS activiteit in rust, wat duidt op een verhoogde autonome spanning onafhankelijk van de specifieke situatie waarin de persoon zich bevindt. Terwijl ANS reactiviteit weergeeft hoe een individu reageert op een stressor (d.w.z. een situatie) weerspiegelt ANS activiteit in rust het vermogen van een individu (d.w.z. een karaktertrek) om emoties te reguleren (Brosschot et al., 2005; Reijman et al., 2016).

Ook onderzochten we kindermishandeling in de context van de familie. In lijn met eerdere studies (Wilson et al., 2008; Cerezo & D'Ocon, 1999) vonden we dat niet alleen ouders, maar ook hun kinderen negatiever communiceerden in ouder-kind paren waarbinnen meer

kindermishandeling voorkwam. Dit kan erop duiden dat kindermishandeling onderdeel is van een verstoorde ouder-kind relatie in het algemeen en zich niet beperkt tot incidentele voorvallen van inadequaaf opvoedgedrag. In lijn met eerdere studies (Giuliano, Skowron en Berkman, 2015; Skowron, Kozlowski en Pincus, 2010) was er ook een grotere mismatch in interactie (d.w.z. de gedragingen van ouders en kinderen sluiten niet aan op elkaar) in ouder-kind paren waarvan de ouders meer verwaarlozend gedrag lieten zien. Opmerkelijk was dat ouder- en kind-gedrag beter leken te matchen in ouder-kind paren waarvan de ouders meer mishandelend gedrag lieten zien. Een spreidingsdiagram (zie Supplementary material, Figuur S5.1) onthulde dat ouders die weinig mishandeling pleegden positiever communiceerden dan hun kinderen, maar het verschil in communicatie tussen ouders en kinderen nam af naarmate de mishandeling toenam. Mogelijk zijn niet-mishandelende ouders beter in staat om positief te blijven ondanks negatief gedrag van hun kinderen met als doel de interactie niet te laten escaleren, terwijl mishandelende ouders zich meer laten verleiden tot het negatief reageren op negatief gedrag van hun kinderen. Onderzoek heeft aangetoond dat mishandelende ouders hypergevoelig zijn als het gaat om negatief gedrag van hun kinderen en gemakkelijker geïrriteerd raken dan niet-mishandelende en verwaarlozende ouders (Bousha & Twentyman, 1984).

Tot slot lieten de bevindingen van de gezinsinteractie taak (Jenga) beschreven in Hoofdstuk 5 zien dat positieve ouder-kind interacties vaker voorkwamen in gezinnen met een hogere gezinscohesie. Een hogere gezinscohesie ging echter niet gepaard met minder mishandelend gedrag binnen een gezin. Dit geeft aan dat de gezinscohesie intact kan zijn, ondanks het voorkomen van kindermishandeling binnen specifieke ouder-kind paren in het gezin. Het is echter ook mogelijk dat we geen lagere gezinscohesie hebben waargenomen in gezinnen waarbinnen meer kindermishandeling plaatsvindt, omdat de gezinnen met de laagste cohesie niet zijn meegenomen in het onderzoek. Tijdens de dataverzameling lukte het bij enkele gezinnen, ondanks grote inspanningen, niet om alle gezinsleden op dezelfde dag te plannen, wat kan duiden op weerstand bij bepaalde familieleden om samen een dag door te brengen.

Conclusie

In dit proefschrift onderzochten we de antecedenten en consequenties van kindermishandeling met een multidimensionale aanpak. Samengenomen kunnen we op basis van de bevindingen verschillende conclusies trekken voor mishandeling en verwaarlozing. Allereerst vonden we intergenerationele overdracht van mishandeling met zowel een multi-informante aanpak als met een enkele-informante aanpak. Intergenerationele overdracht van verwaarlozing vonden we echter alleen wanneer één enkele persoon rapporteerde over ervaren en gepleegde verwaarlozing. Dit duidt erop dat de evidentie voor overdracht van verwaarlozing mogelijk gedreven wordt door het perspectief van één informant. Bovendien hing mishandeling (zowel ervaren

als gepleegd) sterker samen met gedragsmatige reacties van ouders, terwijl ervaren verwaarlozing sterker samenhang met fysiologische (autonome) reacties van ouders. Deze resultaten ondersteunen het belang om onderscheid te maken tussen mishandeling en verwaarlozing zowel in onderzoek als in de praktijk. Verder beoogden we om tot een meer integratief beeld te komen van de antecedenten en consequenties van kindermishandeling door gelijktijdig processen op verschillende niveaus (fysiologie, cognitie, gedrag, familieomgeving) van het functioneren te onderzoeken. Opmerkelijk is dat gedragsmatige en fysiologische reacties van ouders over het algemeen niet met elkaar samenhangen. Meer onderzoek, bij voorkeur longitudinaal, is nodig om het complexe samenspel tussen fysiologische systemen en ouderlijk gedrag beter te begrijpen. In toekomstig onderzoek naar kindermishandeling zou bijvoorbeeld het samenspel tussen gedrag en meerdere fysiologische systemen in verschillende ontwikkelingsperioden bestudeerd kunnen worden. Hoewel het bestuderen van factoren op meerdere niveaus binnen hetzelfde onderzoek allesbehalve eenvoudig is, neemt interdisciplinair onderzoek in de neurowetenschappen en ontwikkelingspsychopathologie toe (Sterne et al., 2009), wat een multidimensionale ontwikkelingsbenadering mogelijk maakt. Een dergelijke aanpak is misschien niet alleen cruciaal voor een beter begrip van de antecedenten en de consequenties van kindermishandeling, maar ook voor het ontwikkelen van interventies die het functioneren van ouders bevorderen.

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Curriculum Vitae

Renate Simone Marianne Buisman werd geboren op 28 augustus 1987 in Zwolle. In 2006 behaalde zij haar VWO diploma aan het Veluws College Walterbosch in Apeldoorn. Aansluitend startte zij haar studie Pedagogische Wetenschappen aan de Universiteit Utrecht. Daarnaast haalde zij in een tussenjaar haar propedeuse in Sociaal Pedagogische Hulpverlening aan de Hogeschool van Utrecht in 2009. Na het behalen van het bachelor diploma Pedagogische Wetenschappen in 2012 rondde zij in 2013 de master Maatschappelijke Opvoedingsvraagstukken cum laude af aan de Universiteit Utrecht. Voor haar master liep zij een wetenschappelijke stage bij het Trimbos-instituut en schreef ze een scriptie over de implementatiekwaliteit van een schoolinterventie gericht op het verbeteren van de sociaal-emotionele ontwikkeling van kinderen in achterstandswijken. Daarna werkte zij gedurende 2 jaar bij het Trimbos-instituut als Junior Onderzoeksmede-werker. Van 2015 tot 2019 was Renate als promovenda verbonden aan de afdeling Forensische Gezinspedagogiek en Jeugdhulpverlening van de Universiteit Leiden. Hier deed zij onderzoek binnen een multigenerationeel familieonderzoek gericht op het samenspel van methodologische, genetische en omgevingsfactoren in de intergenerationele overdracht van emotieregulatie en opvoedstijlen. De resultaten van haar onderzoek zijn beschreven in dit proefschrift. In 2019 is Renate gestart als Postdoctoraal onderzoeker aan de Vrije Universiteit van Amsterdam binnen een onderzoek gericht op de overgang naar vaderschap met een focus op de rol van hormonale en neurale processen.

Publicaties (List of Publications)

- Buisman, R. S. M.**, Pittner, K., Tollenaar, M. S., Lindenberg, J., van den Berg, L. J. M., Compier-de Block, ... & Van IJzendoorn, M. H. (2020). Intergenerational transmission of child maltreatment using a multi-informant multi-generation family design. *PLoS ONE*, *15*(3): e0225839. doi:10.1371/journal.pone.0225839
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